



National Ocean Survey Abstracts-1979

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U. S. DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
National Ocean Survey

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PREFACE

The National Ocean Survey (NOS) provides charts and related information for the safe navigation of marine and air commerce. NOS also furnishes other Earth science data from geodetic, hydrographic, oceanographic, geomagnetic, seismologic, gravimetric, and astronomic surveys, observations, investigations, and measurements.

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Appell, G.

Predicting the response of current meters in shallow water. Near Surface Ocean Experimental Technology Workshop, NSTL Station, Bay St. Louis, Miss.

An approach was developed to predict and quantify the measurement response of current meters in a shallow water environment. A three-phase program of (1) laboratory evaluation, (2) a field experiment, and (3) an error prediction model was developed. These program phases are discussed along with preliminary results.

Appell, G.

A summary of the Grundy model 9021 recording current meter performance in a shallow water environment. Presented to the Fifth STD/Ocean Systems Conference and Workshop, San Diego, CA. Feb. 1979.

The Grundy model 9021 recording current meter is being used in a baseline oceanographic survey at two coastal sites off Louisiana. In support of this survey, the National Ocean Survey's Test and Evaluation Laboratory (T&EL) has established a program to control and quantify the uncertainties of the measurement data collected. Performance and error levels were established on the Model 9021 from laboratory evaluations. A total of 36 Grundy model 9021 recording current meters with conductivity, temperature, and acoustic link were procured for the survey. All instruments were subjected to inspection/acceptance tests procedures, and all measurement parameter uncertainties were quantified. Field check hardware onboard the NOAA ship FERREL verifies the operation and calibration of each instrument during the survey cycles. A recall program was established to periodically perform laboratory tests on specific instruments after a period of field service to verify data quality. This paper documents the results of laboratory tests and the inspection/acceptance results from 36 current meters. It also describes the field performance of the current meters for the first 8 months of the survey.

Appell, G., Frey, H., Crump, D.

An at-sea current meter performance experiment in the Gulf of Mexico. Presented to the Marine Technology Society, New Orleans, La., Oct. 1979.

A 33 day at-sea current meter performance experiment was carried out in the West Cameron Area of the Louisiana shelf beginning April 5, 1979. The objective of the at-sea current meter performance experiment was to obtain, process, and analyze site specific field data necessary to correlate the response of the Grundy Model 9021 current meter with laboratory tests and an error prediction model. The goal of the analysis is to obtain overall uncertainty estimates for the current meter measurements which were made during the Department of Energy sponsored National Ocean Survey Strategic Petroleum Reserve Support Project. All data essential for the estimated overall uncertainty analysis have been obtained. The design of the experiment, results in the field, data processing and analysis, and conclusions are discussed.

Austin, N.

Doppler satellite surveying for hydrographic control. Presented at the sixth annual hydrographic surveying conference, Seattle, Wash.

Doppler satellite surveying can be used to establish horizontal control for hydrography. In the relative positioning mode, the control established can be as close as 5 km.

Austin, N.

Geodetic applications for computer terminals at the Marine Centers. Presented at the sixth annual hydrographic surveying conference, Seattle, WA.

Both the Atlantic Marine Center (AMC) and the Pacific Marine Center (PMC) have the capability to transmit geodetic data to the National Geodetic Survey (NGS) using computer terminals. The Marine Centers can also use the terminals to extract useful information about horizontal control from the NGS Data Base.

Austin, N.

NGS' first inertial system survey. Presented to the sixth annual hydrographic surveying conference.

The National Geodetic Survey (NGS) will be using an inertial system for the first time in 1979. The first inertial survey will be conducted along the Louisiana coast to establish horizontal control from hydrography.

Balazs, E.

Geodetic leveling techniques in use and under development in the U.S. re-leveling program. Presented to the 2nd international symposium on problems related to the redefinition of North American Vertical Geodetic Networks.

In contrast to almost 50 years (1916-1964) of instrumental and procedural stability in the Coast and Geodetic Survey leveling program, many changes have occurred during the past 15 years. This paper will describe new level instruments, level rods, observing procedures, the automated recording system, and updated requirements used by the National Ocean Survey/National Geodetic Survey (NGS) since the releveing program began in 1977.

Balazs, E.

Status report on elevation differences between local mean sea levels in California. Presented to the International Conference on Redefinition of North American Geodetic Vertical Control Network, Jan. 15-18, 1979, Ft. Clayton, Canal Zone.

Comparisons between "free" adjusted normal orthometric leveling elevations and mean sea level at tide stations are given in Braaten and McCombs (1963) for the United States coastlines. Their report indicated an apparent systematic difference between the 1963 free adjustment, which had a mean epoch of 1939, and mean sea level along the coasts. Since that date, new leveling surveys, performed primarily by the NOAA National Ocean Survey's National Geodetic Survey have been completed between San Francisco and San Pedro tide stations for the epochs 1968-1969, 1968-1971, 1971-1972, 1973-1975, and 1977-1978.

Banks, N., Antill, P. (USGS)

Joint Topographic/Bathymetric mapping in the United States of America. 2nd Regional United Nations Cartographic Conference for the Americas. Sept. 3-14, 1979. Mexico City, Mexico.

More than ever before the United States is concentrating its scientific and engineering capabilities toward the development of the oceans' natural resources and toward finding ways to preserve or reduce the impact of these offshore activities on its coastal States. This paper briefly discusses past and current program activities, the purpose of the products, and the cartographic procedures/methods used in their construction.

Banks, N., Antill, P. (USGS)

Topographic/bathymetric maps. Proceedings Conference of Commonwealth Surveyors 1979. Cambridge, England.

The effective administration of coastal zone activities, such as Federal OCS oil and gas leasing and development, near-shore and onshore oil and gas programs administered by States, Federal water pollution activities, and the new Coastal Energy Impact Program, requires maps that accurately delineate land and ocean bottom characteristics. Topographic/bathymetric maps, a relatively new series of coastal zone maps, have been developed to meet this requirement. "Topo/bathy maps" as they are commonly called, combine the data of separate mapping efforts--topography of the land and bathymetry of the ocean--into a single product which can meet widely varied user needs that presently can be met only by using several different maps. These new multipurpose maps are prepared through a joint program of the U.S. Department of Interior's Geological Survey, and the U.S. Department of Commerce's National Ocean Survey, a component of the National Oceanic and Atmospheric Administration.

Bisagni, J.

Physical variability at an East Coast United States offshore dumpsite. Ocean dumping symposium volume, June 1980.

Three hydrostations conducted during cruise 77-05 of the FRS ALBATROSS IV to Deepwater Dumpsite 106 inadvertently sampled an established anticyclonic Gulf Stream ring both prior to and after it interacted with the Gulf Stream. Continuous STD and discrete dissolved oxygen measurements conducted in the ring were analyzed using temperature-salinity (T-S) and temperature-oxygen (T-O₂) diagrams. These data showed good correlation with T-S and T-O₂ diagrams from Gulf Stream, Sargasso and Slope Waters obtained during Endeavor 011 and Knorr 065 and 071 which were part of a cyclonic Gulf Stream ring study. Apparently, a new entrainment of Gulf Stream Water around the ring occurred within the sampling period and was manifested by increased salinity and decreased levels of dissolved oxygen. Combined satellite surveillance and at-sea measurement of temperature, salinity and oxygen provide an accurate method of describing this highly dynamic and variable region in and around Deepwater Dumpsite 106.

Bossler, J.

Activities of the NGS related to earthquake studies. U.S.-Japan conference on development and utilization of natural resources. Dec. 18, 1979, Tokyo, Japan. (LISD)

The activities of the National Geodetic Survey (NGS) of the National Ocean Survey, NOAA, that are related to earthquake prediction lie in the areas of measurement of crustal motion, polar motion, and earth rotation, and in monitoring secular gravity change.

Bossler, J.

New Adjustments of the North American Datum. Presented to the American Geophysical Union Spring Meeting, Miami, Florida.

The new adjustment of the North American Datum is proceeding on schedule. The numerical problems associated with the solution of 500,000 unknown parameters, simultaneously, appear to be minimal. The accuracy of the orientation of the datum will be achieved to an accuracy of several meters and some preliminary results are discussed. The status of our program for predicting the deflections of the vertical will be mentioned. The results of a test adjustment of 3,500 stations using the Helmert Block software system indicate the adjustment can be achieved in an efficient manner. Several new policies affecting a variety of users have been defined and some thoughts related to a posterior error propagation will be discussed.

Bossler, J.

Status of the New Adjustment of the North American Horizontal Datum.
Presented to the IAG-IUGG Annual Meeting, Canberra, Australia, Dec. 1979.

The status of processing the data to be included in the new adjustment is presented. Studies of problems in processing the data in the past 4 years including numerical roundoff studies, computer options, and three-dimensional and orientation considerations, are summarized. The status of the system designed to implement the Helmert Block solution is briefly discussed.

Carter, W.

Comparison of geodetic and radio interferometric measurements of the Haystack-Westford Baseline Vector. Journal of Geophysical Research, Aug. 1979.

A three-dimensional geodetic measurement of the 1.24-km Haystack-Westford baseline vector was performed to verify the accuracy of previously published corresponding radio interferometric (VLBI) measurements. The differences between the baseline length, horizontal components, and vertical component determined by the geodetic measurements and by VLBI were 5, 4, 2, and 22 mm, respectively. After corrections were applied to the VLBI determination of the vertical component to account for a recently-measured, repeatable gravitational flexure associated with the Haystack system, the discrepancy in this component was reduced to 9 mm. Other possible repeatable flexures in the two telescope systems, which have not yet been measured, could either further reduce or increase this discrepancy.

Carter, W.

An elementary introduction to radio interferometric surveying. Submitted to Survey Review, June 1979.

A new generation of instrumentation and computer software is nearing operational status that is expected to make astronomic radio interferometry an important geodetic method by the early 1980's. Unfortunately, very few professional geodesists have become directly involved in the development or use of the method. This paper introduces some of the basic precepts of radio interferometry using vocabulary and concepts familiar to many geodesists from their experience with electromagnetic distance measurements. Only very basic mathematics is used, with the intent of presenting the material in an easily readable form.

Carter, W.

Modern methods for the determination of Polar Motion and UT1. 1979 Precise Time and Time Interval (PTTI) Conference, Feb. 1979. (LISD)

This paper is organized into two major divisions according to the topics: polar motion and UT1. Each division is introduced with a brief review to

provide a minimal perspective for readers unfamiliar with the subject area. The applications of Doppler satellite observations, laser ranging to artificial satellites and the moon, and astronomic radio interferometry to monitoring polar motion and UT1 are discussed. Emphasis is placed on detailing how and what each method is capable of measuring, fundamental limitations are noted, and the present status of the development of each method is reviewed. The paper concludes with a summary of the author's evaluations of the various methods as candidates for the next generation international polar motion and UT1 monitoring service.

Carter, W.

NGS activities to support development of radio interferometric surveying techniques. MIT and Northeast Radio Corp., Haystack Observatory, Mass., June 1979.

An important part of the NOAA National Ocean Survey/National Geodetic Survey (NOS/NGS) mission is to develop improved geodetic surveying methods. Radio interferometry is producing some extraordinary experimental results, and based on the technique, NGS is working closely with researchers in other organizations to develop operational survey systems. One aspect of this involves the performance of special surveys using appropriately selected new operational methods to provide supplemental and comparative data for the analysis and evaluation of radio interferometric surveying (RIS) projects. This paper reviews these NGS activities, including the field procedures, data reduction and analysis, and the results.

Carter, W.

Project POLARIS: status report
Presented at MIT and North Radio Corp., Haystack Observatory, Mass. June 1979.

Under project POLARIS the National Ocean Survey/National Geodetic Survey (NOS/NGS), in close cooperation with the National Aeronautics and Space Administration, is establishing a network of three observatories which will utilize interferometric observations of extragalactic radio sources to regularly monitor polar motion and UT1. The sites will be: The Harvard Radio Astronomy Station (HRAS), near Fort Davis, Texas; the Westford Observatory, near Boston, Massachusetts; and the U.S. Naval Observatory Time Service substation, near Richmond, Florida. Present activities are focused primarily on the upgrading and equipping of the HRAS facility. The station is expected to be in limited operation by the end of 1979; the POLARIS network is expected to be fully operational by 1983.

Carter, W., Fronczek, C., and Pettey, J.

Haystack-Westford Survey. NOAA Technical Memorandum NOS NGS 21, Sep. 1979. PB81 108383.

A special purpose survey was conducted in the vicinity of the Haystack-Westford Radio Observatory complex near Boston, Mass. The survey included a high accuracy network connecting points of interest within the observatory complex, and connections to the North American Datum (NAD) and the National Geodetic Vertical Datum (NGVD). Extraordinary efforts were made to determine the components ΔX_E , ΔY_E , and ΔZ_E , of the Very Long Base Line Interferometry (VLBI) vector baseline between the Haystack and Westford radio telescopes to the highest possible accuracy. This report contains descriptive information on the methods employed in the collection, reduction, and analysis of the survey data, tabulations of the observational data, and numerical and interpretative results of our analysis.

Chappas, W.

Keeping pace with rapidly changing charting demands in the National Airspace System. Presented to the Fourth United Nations Regional Cartographic Conference for Africa, Abidjan, Ivory Coast, Nov. 1979.

Aeronautical charting gained new impetus when it became evident that the aircraft would become an important means of transportation and commerce. However, the development in aeronautical charting was slow and did not occur in a vacuum. Developments in aeronautical charting can, in part, be attributed to the dynamics of aviation and the increase in air traffic. The advent of high performance aircraft, coupled with their ability to fly faster at higher altitudes and greater distances, imposed different charting requirements--navigational aids were more important than topographic detail. The National Ocean Survey (formerly the Coast and Geodetic Survey) responded to that requirement by providing a timely series of accurate and up-to-date instrument navigation charts. This paper addresses the problems encountered in keeping pace with rapidly changing demands in the National Airspace System.

Chappas, W.

Minimum safe altitude warning system. Presented to the Second United Nations Regional Cartographic Conference for the Americas, Mexico City, Sept. 1979, 13 pp.

The Office of Aeronautical Charting and Cartography (AC&C) of the National Ocean Survey (NOS) is committed to certification of terrain and obstacle data used by the Federal Aviation Administration's (FAA) automated Minimum Safe Altitude Warning (MSAW) System. MSAW is a new service being installed at selected airports in the United States. MSAW will generate an alert to the air traffic controller if an aircraft descends below a safe altitude for a given area. This paper addresses the following implementation processes developed by the NOS for MSAW: (1) systems description, (2) systems requirements, (3) terrain and obstacle data analysis, (4) MSAW flight check team, and (5) deliverables to FAA.

Chovitz, B.

Ocean Satellites. Presented to the International Association of Geodesy, Canberra City, Australia. Dec. 1979.

Plans are being formulated for a satellite system to monitor the oceans, analogous to the presently operating meteorological satellites that monitor the atmosphere. Determination of steady-state and time-varying differences between the actual surface and the geoid is essential for resolving the direction and velocity of currents and general ocean circulation. Principal geodetic problems are calculating precise orbits, obtaining high-frequency components of the geoid, and correlating geodetic with oceanographic data.

Cohen, P.

A five-letter word for map. Institute of Electrical and Electronic Engineers Meeting, Sept. 1979.

Bathymetric maps and nautical charts both depict sea floor features having measurable relief or able to be delimited quantitatively by relief. Functional differences between these classes of products determine the procedural use of data in compilation phases, with the recent proliferation of industrial activity in the oceans manifesting itself in increased requirements for unambiguous sea floor information to accepted mapping standards. The sea floor is no longer considered a place one avoids if he is successful, or upon which one grounds a ship if he is not; it is increasingly basic to numbers of engineering and scientific applications. This and other factors pertinent to marine cartographical data are discussed in the context of bringing to the attention of marine engineers and scientists a conceptual framework for assessing the utility of sea floor relief.

Collins, J.

Coastal mapping handbook. American Society of Civil Engineers Meeting, Boston, MA. April 1979.

In 1972, the U.S. Geological Survey (USGS) and the National Ocean Survey (NOS), in cooperation with the American Congress on Surveying and Mapping and the Marine Technology Society, sponsored a Coastal Mapping Symposium. This meeting brought together a number of individuals from the public and private sector to share their problems and experiences in surveying and mapping in the coastal zone. One of the problems identified at this symposium was the lack of a definitive text or reference listing, among other things, of coastal mapping products and services available through the Federal Government. Beginning in 1974, the USGS, NOS, the Office of Coastal Zone Management held a series of work sessions to address this problem. Work was begun immediately on developing a coastal mapping handbook which would describe all the aspects of mapping in nontechnical terms. After a number of draft manuscripts had been prepared, a final draft was sent to coastal states for comments in March 1976, and after incorporating suggested comments, a final text was printed by the Government Printing Office (GPO) in 1978.

Collins, J.

Formulas for positioning at sea by circular, hyperbolic, and astronomic methods. NOAA Technical Report, Feb. 1979.

Today's positioning of a vessel is accomplished by using either hyperbolic (LORAN), circular (Raydist), celestial, or satellite navigation systems. The use of these systems with onboard computers often has created problems for the navigator and computer programmer who is faced with a variety of formulas for computing ships' positions. This report is an attempt to clarify and simplify the formulas and procedures required to correctly compute the position of a vessel on the high seas.

Collins, J.

Legal aspects of photogeodesy. ASP/ACSM Annual Meeting, Washington, D.C. March 1979.

The National Ocean Survey (NOS) recently completed a photogeodetic densification survey of Ada County, Idaho, in cooperation with and at the request of local officials. NOS provided a sparse array of geodetic control by conventional geodetic field techniques and provided a control densification of northern Ada County by photogrammetric techniques. Field work for the photogrammetric operation was accomplished by local private land survey personnel under contract to the county. These surveyors targeted known section corners and the approximate location of non-monumental corners. A later phase of this project involves private surveyors recovering all non-monumented section corners and tying found corners to the targeted photogeodetic points near them. The measured data and records associated with this photogeodetic densification are being carefully documented and retained for possible future defense of this method in the courts. Problems associated with the legal use of photogeodetic control are discussed.

Collins, J.

NOAA's storm evacuation mapping initiative. Orlando, Florida, May 1979. (LISD)

NOAA has been printing storm evacuation maps of the Gulf of Mexico and U.S. east coasts since 1971. These maps are printed in color and show flood prone zones, evacuation routes and critical elevations along the routes, and high points or points of refuge. Populations of towns, route numbers, and geographical names are printed on the maps for information purposes. The critical information contained on the evacuation maps is the road elevations, especially the low points along the road. These low point elevations are critical since they can be flooded prior to the actual arrival of the storm. Flooding of low points along a road, in effect, cuts off the road so that it is no longer an effective evacuation route. Knowing which roads are critical and at what stage of flooding they are cut off is essential to effective evacuation planning.

Collins, J.

Photobathymetry. Presented to the American Society of Civil Engineers, March 1979.

Man has increasingly developed coastal areas in recent years, coastal engineering works such as on-shore processing plants, jetties, pipelines, dredged channels, and other improvements have required a more detailed knowledge of near-shore water depths, or bottom bathymetry. The classical method of determining these required water depths is to conduct hydrographic surveys using small-craft. However, this approach to the problem has three major disadvantages: It's too time consuming, it's too costly, and its coverage is too limited. Photobathymetry, a new remote sensing tool for surveying shallow water areas, provides a solution to this depth determination problem--it's faster, less expensive, and provides full coverage of the underwater area.

Collins, J.

Photogeodesy. American Society of Civil Engineers Special Journal, Aug. 1979.

The National Ocean Survey (NOS) has developed a new remote-sensing system for determining the coordinates of geodetic ground control points, based on the work of Brown (1977) and other pioneers in photogrammetry. The photo-geodetic system developed by NOS consists of: a Wild RC-10 aerial camera with a 6-in. focal length reseat lens assembly, a Mann Stellar comparator equipped with a laser interferometer, a set of computer programs to reduce the data, and a Buffalo aircraft, computers, and related hardware.

Collins, J.

Satellite positioning at sea. American Society of Civil Engineers meeting, Atlanta, Georgia, Oct. 1979.

The precise positioning of vessels beyond a few hundred kilometers from land has presented a seemingly insoluble problem until the advent of satellite positioning. Beginning in the early 1960's, the United States began an extensive program to develop navigation satellite systems for defense purposes. In 1967, commercial applications of U.S. Navy TRANSIT navigational satellites became possible, and the use of this system has steadily increased since this time. Although there have been other satellite positioning systems, the TRANSIT system has been in general continuous use since 1967, and in this chapter will be referred to simply as the satellite system.

Collom, J. and Spencer, J.

National geodetic control diagrams--past, present, and future. 2nd United Nations Regional Cartographic Conference, Mexico City, Mexico, Sept. 1979.

The first geodetic control diagram drawn in 1817 was a project sketch of the first geodetic survey performed in the vicinity of New York City. Briefly,

until the early 1840's, horizontal control (Triangulation) was shown on nautical charts; after that period, for nearly 100 years, control diagrams were shown as project sketches in the final survey reports. This paper traces the developmental stages of geodetic control diagrams in the United States from the Coast Survey's first turbulent decade to the future redefinition of the North American Datum 1983 (NAD83) and the National Geodetic Vertical Datum 1985 (NGVD85).

Damuth, J. (Lamont-Doherty Geological Observatory) and Embley, R.

Mass wasting on the Continental Rise of Eastern South America. AAPG Bulletin, V. 63, p.438 - 1979 AAPG Annual Meeting.

Although slumps and associated deposits appear to be widespread beneath portions of the continental slope, recent studies of sedimentation and near-bottom processes on the continental rise of eastern South America indicate that mass-wasting (slumps, slides, debris flows, etc.) is of only limited or local extent. This conclusion is based on detailed examination of moderate-to close-spaced 3.5 kHz echograms and seismic-reflection profiles plus examination of several hundred piston cores. Zones identified as mass-wasting deposits are usually of small regional extent (<50 km) and are confined to the upper rise or to regions adjacent to many of the large seamount chains (e.g., North Brazilian, Fernando de Noronha, and Columbia-Trindade ridges) which cross the rise. Thus, based on the available data, the continental rise of eastern South America does not appear to have large, widespread slump/debris flow complexes that cover thousands of km^2 and extend hundreds of km downslope as they do on other portions of the Atlantic continental rise (e.g., Northwest Africa and Eastern U.S.A.). However, the present data spacing on the South American rise may preclude recognition and delineation of the regional extent of many mass-wasting deposits.

Damuth, J. (Lamont-Doherty Geological Observatory) and Embley, R.

Upslope flow of turbidity currents on the Northwest flank of the Ceara Rise: Western equatorial Atlantic. Sedimentology, 1979, Vol. 26, pp. 825-834.

A piston core (RC16-57) raised from the northwestern flank of the Ceara Rise contained several turbidites up to 62 cm thick with grain sizes ranging from clay to coarse sand. These turbidites were similar in composition to terrigenous turbidites found throughout the Amazon Cone, continental rise and abyssal plains of the western Equatorial Atlantic. The core site (RC16-57) on the Ceara Rise, however, was 156 m above the level of the adjacent Amazon Cone (the source of the turbidites). Thus the turbidity currents which deposited these beds apparently had a flow upslope for 17 km to reach the core site. Sub-bottom reflectors observed on a 3.5 kHz echogram that extended from the Amazon Cone upslope past the core site suggested that these and deeper turbidites extended from the cone up the rise flank to distances of up to 40 km from the cone/rise boundary and to elevations up to 400 m above the level of the cone at the base of the rise. An equally plausible explanation could be that the turbidity currents that deposited these sediments were in excess of 400 m in thickness and thus would not require uphill flow to

reach their observed location on the rise flank. The absence of terrigenous turbidites from the bases of topographic knolls on the continental rise and abyssal plains throughout the western Equatorial Atlantic indicated, however, that turbidity currents were normally less than 100 m thick and hence would seem to rule out this explanation. The average gradient of the rise flank in this region was about 1:100 ($\sim 0.5^\circ$).

Diamante, J.

An interpolation/extrapolation method for regional mean sea surface and tide model determination using satellite radar altimeter data with application to the GEOS-3 calibration area. American Geophysical Union, San Francisco, CA., Dec. 1979.

The existence of systematic orbit errors at long wavelengths has presented a major obstacle to the extraction of long wavelength tidal signatures from satellite radar altimeter data (Douglas and Goad, Boundary Layer Meteorology, 13, 1978, 245-251). A method has been developed which utilizes reference regions in the ocean where accurate gravimetric geoids and empirical tide models from conventional bottom gage data are available to determine the orbit errors for the portion of each orbital arc passing over these regions. The orbit error signatures along the arcs are determined by extrapolation of the orbit model beyond a single reference region or by the interpolation of the model between reference regions. The mean sea surface and tidal signatures are then extracted from the altimeter data for the extended extrapolation/interpolation areas.

Diamante, J., Douglas, B., and Goad, C.

SEASAT altimeter calibration initial results. Science Magazine, June 1979.

Preliminary analysis of altimeter data indicates that the instrument has met its specifications on measuring spacecraft height above the ocean surface (± 10 cm) and significant wave height (± 0.5 m). There is now ample evidence that the radar altimeter having undergone development through three Earth orbit missions (Skylab, GEOS-3, SEASAT) has reached a level of precision that now permits its use for important quantitative oceanographic investigations and practical applications.

Douglas, B.

Determination of the geopotential from satellite-to-satellite tracking data. American Geophysical Union 1979 Fall Meeting, December 1979, San Francisco, California.

Dinulations were made on the recovery of mean gravity anomalies from inter-satellite Doppler measurements. A pair of surface-force compensated satellites were assumed to be in identical polar orbits, spaced by 3 degrees, at an altitude of 200 km, with intersatellite data having a precision of 0.001 mm/sec. The results for a half-year mission indicate that mean $1^\circ \times 1^\circ$ gravity

anomalies can be obtained to a precision of a few milligals, and $2^\circ \times 2^\circ$ mean anomalies to a few hundredths of a miligal. A so-called high-low case, when one of the satellites is geosynchronous, appears to perform about twice as well, but is probably impractical to use because of the difficulty in obtaining the required data precision (10^{-3} mm/sec) with the long (-36,-00 km) intersatellite distance involved. In contrast to previous analyses, our results are indicative of data obtainable from a global solution free of debatable a priori constraints or assumptions about the geopotential. Thus, a properly optimized mission using additional information, such as results from altimetry or mean surface anomalies, could somewhat improve the results presented here.

Douglas, B., Balazs, E.

Geodetic leveling and the sea level slope along the California coast. JGR, Summer 1979. PB80 120611.

Comparisons between "free" adjusted normal orthometric leveling elevations and mean sea level at tide stations are given in Braaten and McCombs (1963) for the United States coastlines. Their report indicated an apparent systematic difference between the 1963 free adjustments, which had a mean epoch of 1939, and mean sea level along the coasts. Since that time new leveling surveys, performed primarily by the National Ocean Survey's National Geodetic Survey, have been accomplished between San Francisco and San Pedro tide stations for the epochs 1968-1969, 1968-1971, 1971-1972, 1973-1975 and 1977-1978.

Dracup, J.

Control surveys. Presented to the International Union of Geodesists and Geophysicists, December 1979.

The progress of geodetic control surveys in the United States has been enhanced by the increased use of sophisticated instrumentation during 1975 to 1978. Although this report summarizes only the national and international activities of the several Federal agencies that establish geodetic surveys, significant accomplishments have also been made by state, county, and private organizations. Many of these organizations submit their observational data or adjusted results to the National Ocean Survey (NOS) for adjustment and/or publication in accordance with the detailed instructions provided for such submissions. As a result, more control of acceptable accuracy is being made available to the user. Geodetic control which was established from January 1, 1975, to December 31, 1978, by various Federal agencies is summarized under the following headings: horizontal control, vertical control, and geodetic astronomy.

Dracup, J.

Horizontal control data. NOAA Technical Report, June 1979.

The horizontal geodetic control network of the United States consists of about 230,000 stations of first-, second-, and third-order accuracies. This vast network has been in a continuing state of development since 1832. Originally, progress was very slow, but as new, improved instrumentation developed, vast strides were made. Today, surveys can be made to accuracies which were impractical only a few decades ago. This improvement is attributed to advances in electronics, and especially satellites and quasars. The publication and maintenance of up-to-date data are a tremendous task, made manageable with automation. When the new adjustment of the North American Datum is completed in 1983, the adjusted data will represent the optimum results obtainable from the observations.

Embley, R., Hobart, M., and Anderson, R.

A very high heat flow anomaly over 80 million year old Atlantic Ocean floor. EOS, Vol. 60, No. 18, May 1, 1979.

A heat-flow survey was carried out at the eastern edge of the Nares Abyssal Plain in November 1978, over an area of 80 million old seafloor. This area is unusual in that there are a number of structures or domes projecting above the abyssal plain, which appear to be acoustically transparent from surface 3.5 kHz echosounder and seismic profiler records. A line of closely spaced heat-flow measurements across one of the domes shows an anomaly 600 m wide rising to a peak value of 764 mW/M^2 from values of 63 mW/m^2 . An additional line of measurements over abyssal hills nearby shows variability from $40 - 120 \text{ mW/m}^2$. Three other lines over the abyssal plain and abyssal hills show little variability from 63 mW/M^2 . A piston core from on top of a dome recovered 5 m of brown clay and a semilithified orange crust with embedded pieces of altered basalt. We interpret these results as showing highly effective convective heat transfer within the crust through a permeable chimney resulting in the high observed conductive heat-flow on the dome. The other profiles show that there is convection in some, but not all, of the surrounding areas. The thin sediment cover over the domes compared to the surrounding hills implies either a younger age or a reduction in the sedimentation rate atop the domes. These domes may be an active analog of the basement chimney drilled at DSDP Site 417A.

Embley, R., and Johnson, D. (Woods Hole Oceanographic Institution)

Acoustic stratigraphy and biostratigraphy of neogene carbonate horizons in the North equatorial Pacific. EOS, Vol. 60, No. 46, Nov. 13, 1979.

The Clipperton Fracture Zone in the Equatorial Pacific defines the first-order sediment facies boundary, with calcareous-siliceous ooze lying to the south, and carbonate-poor siliceous ooze in the deeper regions to the north. Distinctive acoustic reflectors and low-frequency (air gun) and high-frequency (3.5 kHz) profiles from north of the fracture zone have been identified

in 13 piston cores from the same region, and correspond to "carbonate spikes" (CaCO_3 content up to 80%) within an otherwise carbonate-free sediment. The reflectors have northern limits which increase with increasing age; reflector R_0 (late Pleistocene) occurs only south of $\sim 50^\circ\text{N}$; R_1 (upper Miocene) occurs south of $\sim 60^\circ\text{N}$; and R_2 (middle Miocene) extends to at least 100°N . Physical property measurements indicate that the acoustic reflectors represent sharp decreases in porosity, increases in wet-bulk density, and decreases in sound velocity. Radiolarian biostratigraphy of the cores shows that the most extensive of the reflectors, R_2 , is clearly time-transgressive within the middle Miocene. The geographic extent and time-transgressiveness of individual acoustic reflectors are probably a consequence of the northward motion of the Pacific plate during the Neogene. Eastward and Arctic Bottom Water flow between the Clarion and Clipperton Fracture Zone has modified this first-order depositional pattern by creating local erosional unconformities on a scale of km or less.

Embley, R., and Malahoff, A.

Distribution, morphology mechanisms and ages of sediment slides on the U.S. Eastern Continental margin: Cape Cod to Florida. AAPG Bulletin, V. 63, p. 444-445.

Recent mapping off eastern North America has revealed four areally-extensive slide zones between the Blake-Bahama Outer Ridge and Long Island. These slide zones are recognized on the basis of 3.5 kHz records and by the structures present in piston cores. The distribution of piston cores containing slump and debris-flow structures indicates that mass movements have taken place in this region on a wide scale and that slumping and sliding of sediments from the slope and upper rise onto the middle and lower rise is ubiquitous to the region during recent geologic time.

Enabnit, D.

Airborne hydrography system limited design report. NOAA Technical Memorandum September 1979.

The National Ocean Survey (NOS) has been investigating airborne laser hydrography since 1970, to determine if the technique could be used to perform accurate hydrographic surveys at a significantly reduced cost and with significantly reduced manpower. Using the airborne laser hydrographic technique, an aircraft-mounted, pulsed laser system collects a swath of discrete soundings along each flight line. It measures water depth exactly like a sonar but uses light instead of sound. The NOS operational system will take 600 soundings/sec over a 200 m wide swath, with an average distribution of $1/25 \text{ m}^2$. The system will operate from a light, twin-engine aircraft flying at 300 m, and 75 m/sec. The laser will have a green wavelength for maximum water penetration and will be totally eye-safe for bystanders in the survey area.

Enabnit, D.

Airborne laser hydrography. 2nd United Nations Regional Cartographic Conference for the Americas, September 1979.

Airborne laser hydrography is an emerging technology which has the potential of performing large amounts of bathymetric surveys rapidly and inexpensively. The accuracy, applicability, and economics of laser bathymetric surveying are discussed. The characteristics of a scanning laser bathymetric system being developed under the direction of the Defense Mapping Agency are presented.

Flagg, J.

The National Ocean Survey's Strategic Petroleum Reserve Support. Ocean Industry Magazine, November 1979.

The federal Strategic Petroleum Reserve authorized by the Energy Policy and Conservation Act of 1975, was created in response to the 1973-1974 oil embargo's drastic disruptions to the U.S. economy. The Department of Energy (DOE), responsible for developing and implementing the SPR program, plans to store up to 1 billion barrels of crude oil under Louisiana and Texas in caverns produced by solution-mining subterranean salt deposits. A combination of characteristics make crystalline (rock) salt caverns highly attractive for petroleum storage. If the crystalline salt is relatively pure--not imbedded with significant quantities of other types of rock--it is generally impervious to liquid and gas, has a compression strength comparable to concrete under the weight of overlying and surrounding rock, moves like plastic to seal incipient fractures, and can be relatively easily mined by dissolving with water. The dissolved rock salt forms a saline solution of approximately 265 parts salt per thousand parts water, and has a temperature range of 27 to 37 degrees C. According to the Department of Energy, salt dome petroleum storage is feasible wherever an adequate water supply and conditions for brine disposal coexist.

Floyd, R.

Stable and enduring monuments for the U.S. National Geodetic Vertical Control Network. Presented to the International Conference on the Redefinition of the North American Geodetic Vertical Control Network, Panama City, Panama. January 1979.

Bench marks, or survey control points of known elevation, are used by geophysicists for many purposes, but problems inherent with bench marks have long hindered the scientist. These problems include instability, deterioration, damage, and destruction of the monument. They can be overcome by prudent selection of level line routes and bench mark sites, and by use of a suitable monument. Disks set in sound bedrock are always best. If unavailable, a suitable structure or specially designed monument can be used. The class A rod mark, developed by the National Geodetic Survey, National Ocean Survey, NOAA, is one such monument.

Fornari, D. (Lamont-Doherty Geological Observatory of Columbia University), Malahoff, A. and Embley, R.

Visual observations of biological erosion in submarine canyons along the Northeast U.S. coast. EOS, Vol. 60, No. 18, May 1979

Extensive geological observations have been made in several submarine canyons along the northeast U.S. margin using U.S. Navy submersibles and ALVIN. The primary objectives of the canyon diving were identification and correlation of outcropping pre-Pleistocene horizons with coastal stratigraphy from borholes, and geologic and subsidence history of the canyons and northeast shelf and slope areas. As the number of hours of dive observations increased we realized that one aspect of canyon dynamics that was always correlatable between various dives and locales was the presence of vigorous biological erosion of the northern wall of each canyon by mobile and sessile benthic organisms. Additional bioerosion occurs in the intercanyon areas and lower-canyon depositional fans and is principally the result of digging and tunneling by the deep-sea red crab Geryon quinquedens. This crab was observed to actively attack the exposed bedding planes on both steep and gentle slopes while digging catacombs that serve as resting and hiding places. The long term effect of the extensive digging by crabs and to a lesser extent fish, which were seen diving into the upper sediments, is to cause local slumping and retreat of the slope usually in an up-bed direction. Bioerosion of the canyon heads, intercanyon and down-canyon areas is both texturally and faunally distinct and is considered to be one of the major modifying agents operating in the dynamic regime of submarine canyons.

Fornari, D. (Lamont-Doherty Geological Observatory), Malahoff, A., and Heezen, B. (Lamont-Doherty Geological Observatory)

Visual observations of the volcanic Tortuga, Lorraine and Tutu seamounts; and petrology and chemistry of Ridge and Seamount Features in and around the Panama Basin. Marine Geology, 31, pp. 1-30, 1979.

Visual observations from four submersible dives employing the U.S. Navy's "Turtle" have defined the genetic differences between Tortuga Seamount, a submarine volcanic edifice on the northwest flank of Cocos Ridge and Lorraine Seamount which, although physiographically isolated, is a tectonic fragment of Cocos Ridge. The micromorphology of Tortuga Seamount is dominated by constructional volcanic escarpments which mark the downslope ends of extrusive submarine flow units which are inferred to coalesce, in both a vertical and horizontal sense, to build the seamount. The west flank of Lorraine Seamount lies at the northern end of the fracture zone at 85°W and is composed of en-echelon, steep westward-dipping fault scarps whose faces are visibly tectonized. Distinct differences between the volcanic micromorphologies of these features have implications bearing on the volcanic processes associated with oceanic seamount construction. Major- and trace-element data for samples recovered in situ by "Turtle", and other samples dredged and drilled from various locales within the Panama Basin, delineate distinct chemical and genetic differences between the Ti-rich tholeiitic suite from aseismic ridge features within the Panama Basin and the alkali basalt suite from the seamounts which lie just outside the Panama Basin on the northwest flank of Cocos Ridge.

Fornari, D. (Lamont-Doherty Geological Observatory), Peterson, D. (U.S. Geological Survey), Lockwood, J. (U.S. Geological Survey), Malahoff, A., and Heezen, B. (Lamont-Doherty Geological Observatory)

Submarine extension of the Southwest rift zone of Mauna Loa volcano, Hawaii: visual observations from U.S. Navy Deep Submergence Vehicle DSV SEA CLIFF. Geological Society of America Bulletin, Part I, v. 90, pp. 435-443, May 1979

North-south trending dikes exhibiting well-developed columnar jointing have been visually observed on a series of submersible dives to the submarine extension of the southwest rift zone of Mauna Loa Volcano, Hawaii. These dikes are exposed along a west-facing 1,900-m-high scarp that is the sea-floor expression of the southwest rift zone. They form prominent walls, 10 to 60 m high and 1 to 3 m thick at their crests, separated by sediment and rubble-mantled benches. The talus at the base of each dike consists of faceted blocks of basalt broken from the face of the wall. Major-element analyses of samples collected in situ show the rocks to be of "normal" Mauna Loa tholeiite composition.

Fornari, D. (Lamont-Doherty Geological Observatory), Malahoff, A., and Heezen, B. (Lamont-Doherty Geological Observatory)

Submarine slope micromorphology and volcanic substructure of the Island of Hawaii inferred from visual observations made from U.S. Navy Deep-Submergence Vehicle (DSV) "SEA CLIFF." Marine Geology, 32, pp. 1-20, 1979

Based on visual observations made during forty-four submersible dives around the Island of Hawaii we are able to identify distinct morphological provinces which comprise the submarine slopes of the island. The micromorphology of each submarine slope is primarily a function of the distance from active volcanism, and age and structure of the adjacent subaerial volcanic shield. The ages of the submarine slopes around Hawaii progress from young submarine extrusive terrane off the east coast on Puna Ridge, clockwise to older carbonate-mantled submarine slopes and terraces off the northwest and northern coastlines. The transition between each submarine slope morphology is gradational and depends on the mechanical and chemical weathering of the pillow lavas and the structural setting of the adjacent shield. An exception to the clockwise age-progression of the submarine slopes was discovered west of Kealahou Bay, midway along the west coast of Hawaii. Very fresh submarine lava flows and possible submarine vents overlie older submarine extrusive terrane and normal, volcanic rubble and sediment-covered submarine slope terrane. Extrapolation of lateral and vertical contact relationships and submarine slope micromorphologies into the center of Hawaii, coupled with previously published geological and geochemical data allows us to construct a schematic model of the volcanic substructure of Hawaii. This model calls for the three-dimensional interfingering of volcanoclastic wedges with subaqueously extruded pillow lavas below and subaerial shield lavas above. Visual observations and our substructure model indicate that the major portion of the volcanic pedestal which underlies Hawaii is composed of pillow lava sequences.

Frey, H.

NOS Strategic Petroleum Reserve Support: an overview. Proceedings of the Fifth STD/Ocean Systems Conference and Workshop, San Diego, California, March 1979.

The Strategic Petroleum Reserve (SPR) is being implemented by the Department of Energy (DOE) pursuant to the Energy Policy and Conservation Act of 1975. DOE proposes to store up to one billion barrels of crude oil in caverns under Texas and Louisiana which will be produced by the solution-mining of subterranean salt deposits. The process will result in a saturated brine which will be displaced by pumping crude oil into the caverns. Disposal of the brine by pumping it into the Gulf of Mexico is being considered as an alternative. The National Oceanic and Atmospheric Administration (NOAA) has been engaged by DOE to assess the environmental consequences of pumping saturated brine into coastal receiving waters. The Environmental Data and Information Service (EDIS) is providing program and data management and synthesis of the results. The National Ocean Survey (NOS) is characterizing the physical oceanography of two candidate brine disposal sites off the coast of Louisiana. NOS began a one-year field effort during June 1978 at the Weeks Island and West Hackberry candidate brine disposal sites. Intensive instrument evaluation, inspection and acceptance testing, and calibrations were performed by the NOS Test and Evaluation Laboratory to mobilize for the project. Platform and mooring design, data translation hardware, instrument check and verification apparatus and integrated logistics support were provided by the NOS Engineering Development Laboratory. The physical oceanographic field effort is supported by the NOAA Ship FERREL. The NOAA Ship MT. MITCHELL performed registered hydrographic surveys of the sites. Emphasis is placed on data quality assurance which includes physical and environmental evaluation of instruments, sensor field check procedures, recalibrations, sensor data quality acceptance and rejection levels, error modeling and expressions of total measurement uncertainties for each measurand. The NOS/SPR Support data set consists of quasi-synoptic monthly CTD profiles and salinity and dissolved oxygen determined from water samples taken at 3 levels. The synoptic data are obtained at 7 stations within each site and at 2 trackline stations between the sites. Time series records are also obtained from recording instruments; these include water levels, current speed and direction, water temperature and conductivity, air speed and direction, air temperature and barometric pressure. Wave data are obtained every 4 hours by burst-sampling with a pressure-type wave gage at each site center.

Frey, H.

Oceanographic and meteorological observations on the inner Louisiana shelf during tropical storm DEBRA. 1979 Fall meeting of the American Geophysical Union, San Francisco, California, December 1979.

Tropical Storm DEBRA made landfall on the Louisiana Coast at approximately 0030 GMT on August 29, 1978. The storm track passed through an 18.5-km (alongshore) by 7.4-km (transhore) site, which was under physical oceanographic study by the National Ocean Survey (NOS). Depths within the study site range nominally from 8 m to 11 m. The center of the site is 29°40.0' north latitude,

90°28.0' west longitude, near the Calcasieu Pass. Roberts rotor-type current meters, attached to subsurface platforms at 1 m and 3 m above the sea floor, recorded current speed and direction, temperature, and conductivity at 5-min intervals. A wave gage attached to a subsurface platform 2 m above the bottom recorded instantaneous water levels every 0.5 sec for 7.5-min durations at 4-hr intervals. Wind speed and direction, air temperature, and pressure were recorded at 10-min intervals by a meteorological station mounted 19.5 m above the sea surface on an oil production platform. Estimated uncertainties associated with the recording instrument measurements are known with confidence, owing to emphasis which was placed on data quality assurance. In addition to the data obtained by the fixed recording instrumentation, observations were made by the NOAA Ship MT. MITCHELL, a NOAA P-3 weather aircraft, the Lake Charles Airport, and SEASAT I. Although Tropical Storm DEBRA was not among the most severe storms to impact the Gulf of Mexico Coast, it was particularly well documented. Data obtained by the National Ocean Survey are presented with preliminary analyses.

Frey, H.

Physical oceanography on the inner shelf in connection with the Strategic Petroleum Reserve. Chesapeake Chapter's September meeting, Institute of Environmental Sciences, Laurel, Maryland, September 1979. (LISD)

The U.S. Department of Energy (DOE), responsible for developing and implementing the \$8 billion Strategic Petroleum Reserve Program, plans to store up to one billion barrels of crude oil under Texas and Louisiana in caverns produced by the solution mining of salt deposits. Disposal of large amounts of saturated brine into inner shelf receiving waters is contemplated. DOE has requested that NOAA provide site specific environmental assessments and monitoring plans for brine discharges. The NOAA program, managed by the Environmental Data and Information Service, includes intensive physical oceanographic studies of two potential brine disposal sites along the Louisiana coast by the National Ocean Survey (NOS). The two potential disposal sites, known as Weeks Island and West Hackberry after the inland locations of the subterranean salt caverns, were instrumented by NOS for a 12-month period beginning June 1978. Time series records of current speed and direction, water temperature and conductivity, water levels, and waves were obtained by instruments affixed to subsurface platforms. Time series records of wind speed and direction and air temperature and pressure were obtained by instruments mounted on oil production platforms. In addition to the time series records, NOS performed monthly CTD and water sample casts; water samples were analyzed for salinity and dissolved oxygen. During October 1978, surface currents were tracked by photogrammetry. Four different types of extreme meteorological events occurred during the 12-month study: (1) Tropical Storm DEBRA, (2) an extratropical cyclone, (3) a "norther", and (4) a "souther"; these were recorded in detail. Special emphasis was placed on data quality assurance, and, owing to this emphasis, the estimated uncertainties associated with the NOS measurements are known with confidence.

Gaborski, P., and Douglas, B.

Observations of a mesoscale circulation phenomena using SEASAT altimeter data and digital infrared imagery. American Geophysical Union spring 1979 meeting. Washington, D.C., June 1979.

A comparison of SEASAT altimeter data with digital infrared imagery from the NOAA-5 satellite is made of the Western North Atlantic. Current techniques used to identify circulation phenomena involving the use of infrared photography to provide a measure of sea surface temperature and its gradients. With the recent availability of a precise altimeter (RMS = 10 cm) aboard SEASAT, these mesoscale (~ 100 km wavelength) circulation features can be observed in greater detail. Using both a 5' x 5' gravimetric geoid and a GEOS-3 mean sea surface as separate reference sources, the altimeter data are reduced and filtered to eliminate long wavelength effects, such as tidal and orbital errors. The resulting profile is then compared with the simultaneous sea surface temperature profile obtained from the digital infrared image. In particular, two warm core rings located north of the Gulf Stream are observed using both sensors.

Gergen, J.

The relationship of Doppler satellite positions to the U.S. Transcontinental Traverse. 2nd International Geodetic Symposium on Satellite Doppler Positioning, January 1979, Austin, Texas.

The extensive U.S. Transcontinental Traverse (TCT) has many stations at which Doppler Satellite positions have been determined. During the past few years, several investigations have been carried out to determine the precision of Doppler positions. Several different methods of analysis have been employed, and the precision of Doppler positions is well known. This investigation used a refined method of determining the orientation and the scale of the Doppler system which was made possible by using TCT positions derived through a simultaneous adjustment of the entire network. The paper presents the statistics from the TCT adjustments, the seven parameters of the NAD 27 Datum, as well as the analysis of residuals after the least squares fit. The U.S. Transcontinental Traverse (TCT) consists of 47 horizontal field projects observed over a period of 16 years. The direction, distance, and astronomic azimuth observations were made with high precision, rendering adjusted observations with an accuracy of 1 part per million (ppm) (Meade 1974).

Gill, S., Porter, D.

Comparison of results from a simple Defant model with observed offshore tides. Journal of Marine Geodesy, June 1979.

A simple Defant model, based on the M_2 constituent, is presently used by the National Ocean Survey to estimate the offshore range of the tide, with observations at coastal tide stations of the actual tide supplying the necessary boundary condition for the model. The calculated values provide preliminary tide correctors for soundings obtained in offshore hydrographic

surveys. Using offshore tide data from Deep Sea Tide Gage (DSTG) deployments and Offshore Telemetry Tide System (OTTS) buoys, the quantitative effects of the continental slope and shelf on the incoming semidiurnal tide are discussed, and anomalies in the predicted tide curve due to Hurricane Belle are shown. Comparison of the observed tide range with the theoretical tide range reveals the need to modify the initial Defant model, which is accomplished by decomposing the range into its major harmonic constituents, resulting in an improved calculated offshore range.

Goad, C.

Geophysical noise sources affecting worldwide plate tectonic motion measurements. Presented to the International Association of Geodesy XVII General Assembly of the International Union of Geodesists and Geophysicists. December 1979, Canberra, Australia.

Measurements of geometrical positions at worldwide locations by means of high-mobility LAGEOS ranging and VLBI stations are expected to start soon. The number of the geophysical noise sources which will affect the results are the same or similar for both techniques. The main ones are short period fluctuations in the earth's rotation rate and polar motion; uncertainties in ocean tide models, which influence the station positions via ocean loading; distortions of the earth due to nontidal surface loading variation, and uncertainties in the atmospheric refraction corrections due to the dry part of the atmosphere. Additional geophysical factors affecting LAGEOS ranging are displacements of the mantle with respect to the center of mass orbital effects due to the following: ocean tide model uncertainties, gravifield uncertainties, seasonal variations in J_2 , variations in radiation pressure due to changes in the earth's albedo, and small changes in drag. The main additional geophysical factor for VLBI is the uncertainty in the atmospheric water vapor content. Possible ranges of uncertainty in each of the above effects during the next few years will be discussed. A related geophysical problem concerns the choice of sites to be used in establishing a worldwide reference frame for geodynamics studies. Such a frame should be tied to reference points in stable regions that are maintained either by means of fixed observing stations or by fairly frequent remeasurements with mobile stations. For LAGEOS ranging, tradeoffs must be considered between locating fixed stations at stable sites to help in maintaining the reference frame versus locating them at globally distributed sites with low cloud cover. Such global good-weather sites would contribute more strongly to maintaining accurate knowledge of the satellite orbit and to monitoring UT1 and polar motion variations.

Goad, C.

Gravimetric tidal loading computed from integrated Green's functions. Journal of Geophysical Research and NOAA Technical Memorandum, NOS/NGS PB80 128903.

The usual method of predicting the effects of ocean tides on geodetic measurements is to utilize impulse response functions (called Green's functions) by convolving them with the desired ocean tide model. However, this technique

has two shortcomings. First, it does not include effects of the position of the instrumentation above sea level. Second, if only sequences of load deformation coefficients are available, users must generate their own set of response functions requiring the summation of an infinite series which diverges as the angular argument approaches zero. Because ocean tide representations are usually expressed as areas or cells of constant amplitude and phase, it has been found that the integrals of Green's functions are more desirable for use with tidal loading calculations. The height of the instrument above sea level is also easily included with this technique.

Goad, C.

Relative positioning with GPS. American Geophysical Union Spring 1979 meeting, Washington, D.C., May-June 1979.

This year the Department of Defense is scheduled to have in operation six Global Positioning System (GPS) satellites providing timing and 3-D position recovery potential to North American during certain segments of a day. By the mid-Eighties, continuous timing and 3-D recovery from 24 GPS satellites are scheduled. Although the GPS is designed for fast position recovery to the 10-m level, extended data collection periods could yield subdecimeter relative positioning on a routine basis. The results of such data collection schemes using the pseudo-random code and phase measurements of the reconstructed carrier will be presented.

Grundig, L., and Bossler, J.

Feasibility study of the conjugate gradient method for solving large sparse equation sets. NOAA Technical Memorandum NOS/NGS. December 1979. (PB80 280235)

A feasibility study was performed to determine the effectiveness of various conjugate gradient methods for solving large sparse equation sets. Equations of this magnitude will be involved in the future new adjustment of the North American Datum. The conjugate gradient method provides a suitable algorithm for this purpose. Some typical nets associated with the new adjustment were used and compared with a direct solution algorithm. The results indicate this method is well suited for constrained adjustments of triangulation networks, but not for free adjustments. No benefits were derived from preconditioning, which only increased the solution time.

Hansen, R.

The cartographic contributions of Matthew Fontaine Maury. The American Cartographer. March 1979.

Matthew Fontaine Maury, the 19th-century geographer, oceanographer and meteorologist, was one of the earliest "men of science" employed by the Federal Government and contributed much to the advancement of contemporary marine cartography. Herman Friis in his article "Statistical Cartography in the United States" calls Maury "one of the most competent early statistical

cartographers." Indeed, the influence Maury had on marine cartography through the development of his wind and current charts remains today. Born near Fredericksburg, Va., in 1806, Maury was educated and spent most of his formative years at the Harpeth Academy in Tennessee. He joined the U.S. Navy in 1825 and was soon sharing quarters with other naval personnel aboard ocean going vessels. As early as 1831 Maury was ship-master aboard the U.S.S. Falmouth and in this capacity searched for material to aid him in a swift passage across the Pacific. He apparently was surprised at the paucity of wind, current and temperature materials extant. One of Maury's early writing ventures was A New Theoretical and Practical Treatise on Navigation published in 1836. Very quickly this book became the standard text for training Navy enlisted men and certainly aided the advancement of Maury's career. With additional articles recommending naval reform as well as the establishment of a naval academy, Maury, in 1842, was placed in charge of the Navy Depot of Charts and Instruments. In 1844, with the completion of the new National Observatory building, Maury was named the Observatory's superintendent.

Hicks, S.

Sea level expedition to the Aleutian Island. EOS Transactions of the American Geophysical Union, vol. 60, no. 16, April 17, 1979, p. 200.

The National Ocean Survey will conduct an oceanographic expedition to the Aleutian Island this spring. Scheduled to depart Seattle, April 18, the NOAA Ship DISCOVERER will cross the Gulf of Alaska to the Shumagin Islands. The ship will then cruise in an arc just south of the Aleutians to Attu, returning eastward in an arc north of the Aleutians in the Bering Sea to Unimak Pass. On entering the Pacific again, the ship will round the Shumagins, returning to Kodiak on May 3. The principal program of the expedition is to conduct oceanographic leveling between the National Ocean Survey tide stations at Kodiak, Sand Point, Dutch Harbor, Adak, Shemya, and Attu. Of equal importance is the deployment of deep-sea bottom-mounted seismographs just south of the chain in a cooperative program with the University of Texas. A water-mass comparison study will also be made of Bering Sea waters north of the Aleutians and Pacific waters to the south. Sounding verification lines will be run, and a deep temperature profile taken across the Gulf. In addition, a biological oceanography program will be conducted for the Smithsonian Institution.

Hicks, S.

Tidal datums and the new Gulf Coast low water datum. Pilot Chart back page for the Defense Mapping Agency Hydrographic/Topographic Center. Nov. 1979.

Now that chart datum on about half of all National Ocean Survey (NOS) nautical charts of the Gulf of Mexico coast has been converted from Mean Low Water to Gulf Coast Low Water Datum, it would seem appropriate to examine the nature of tidal datums in general and the new Gulf datum in particular.

Holdahl, S.

Height systems for North America. Presented to the Planning Conference on Readjustment of the North American Level Networks, Panama City, Panama, Jan. 1979.

A new height system will be defined in conjunction with the simultaneous readjustment of North American level networks. The adjustment can be accomplished in geopotential units based on real gravity values. A single height datum should result for all of North America. A common method for converting geopotential numbers to heights can be adopted by all countries, the Helmert height is recommended because of its orthometric correctness and because the reference surface (geoid) is equipotential. Other decisions which affect the height system must also be made, such as how to best use oceanographic information in determining the height, which corrections to apply to the observations before adjustment, and how to computationally reconcile data that is not homogenous because of crustal movements. It is recommended that working groups be established to review alternatives in these special fields of investigation.

Holdahl, S.

Report of the North American subcommission on recent crustal movements. International Symposium on Recent Crustal Movements, December 1979, Canberra Australia.

This report is intended as a brief review of significant crustal movement investigations made since 1975, and to relate what are considered to be the computational and technological advancements which are most important for geodynamics. Because of the great number of studies underway, some notable contributions are likely to have been overlooked. To obtain a more comprehensive and detailed picture of current and future geodynamics research projects in North America, the reader should especially review the following four publications: Proceedings of the 1977 CRCM Symposium (Palo Alto, 1977), Tectonophysics, Vol. 52, 1979; Proceedings of the 9th GEOP Conference, Dept. of Geodetic Science Report #280, Ohio State University, Columbus, Ohio, 1978; Applications of Space Technology to Crustal Dynamics and Earthquake Research, NASA, Office of Space and Terrestrial Applications, Washington, D.C. 20546; and Contemporary Crustal Movements in Canada, Can. J. Earth Sci., 16 (3), March 1979.

Hothem, L.

Coastal geodetic control by Doppler satellite surveys. Proceedings of Symposium on Measurement, Mapping and Management in the Coastal Zone from Virginia to Maine. August 1979.

Doppler satellite observations of the Navy Navigation Satellite System (NNSS) are increasingly being used as a rapid, accurate, and economical means of establishing horizontal and vertical control. It is possible to achieve high-order accuracies by Doppler relative positioning methods even

when using the "broadcast" ephemerides. Preliminary analysis of results from a limited Doppler test survey carried out in the Apostle Island area of Lake Superior by the National Ocean Survey/National Geodetic Survey (NOS/NGS) indicates that sub-meter relative accuracies can be achieved. The Apostle Island Test Survey was the first step by NOS/NGS to validate accuracies of Doppler relative positioning for stations spaced less than 50 km apart by using a semi-short arc computer program developed by the Geodetic Survey of Canada. The test results indicate that Doppler surveys are a viable alternative to conventional methods for meeting second- and third-order control requirements in support of mapping, charting, and cadastre surveys.

Hothem, L.

Determination of accuracy orientation and scale of satellite Doppler point-positioning coordinates. Proceedings of the 2nd International Geodetic Symposium on Satellite Doppler Positioning. January 1979.

Over the past 5 years, several Doppler observation campaigns in the United States have been carried out to determine the accuracy, orientation, and scale of satellite Doppler positions by comparison with external standards. The Doppler observations were reduced by the National Ocean Survey using the standard point-positioning program and the "precise" ephemeris. During the early campaigns, the data sets were collected independently of each other at stations tied to the transcontinental traverse and at extraterrestrial geodetic system sites that included mobile and fixed Very Long Baseline Interferometry (VLBI), Deep Space Network (DSN), and Lunar Laser Ranging (LLR) stations. Intercomparisons conducted during 1978 in which special procedures were followed included, for the first time, data from Satellite Laser Ranging (SLR) stations. The number of observations made at each station was increased, atomic frequency standards were used, and the stations were occupied simultaneously. The precision of the Doppler results was at the 30-cm level in each coordinate. These intercomparisons indicated that a scale decrease of 0.4 ± 0.1 ppm and a longitude rotation of 0.80 ± 0.05 arc second eastward should be applied to the Doppler coordinates. No systematic pole error at the 0.05-arc-second level was detected.

Hubbard, J.

Information and Services of the Tides and Water Levels Division, Office of Oceanography, National Ocean Survey. Proceedings of the American Society of Civil Engineers Symposium, November 1979.

The National Ocean Survey, formerly the U.S. Coast and Geodetic Survey, has collected and analyzed marine data since 1834. Since that time, the ever-increasing economic and political importance of the coastal environment has accelerated the demand for an efficient and responsive data management system. The information and services available from the Tides and Water Levels Division and other programs within the Office of Oceanography, NOS, are briefly described. The Tides and Water Levels Division presently is responsible for the operation and maintenance of 130 permanent tide gages (primary control) throughout the United States, 54 water level gages on the Great Lakes, and approximately 300 short-term gages in the overall program.

Huff, L.

Hydrographic system development. Presented to the 1979 Corps of Engineers Hydrographic Survey Conference, December 1979, Wilmington, North Carolina

The Engineering Development Laboratory of the National Ocean Survey is currently working on three projects in support of hydrographic surveying. These projects are: (1) Tide Telemetry; (2) Vessel Motion Correction; (3) Airborne Laser Hydrography. The first two are aimed at automatically providing the corrections which must be applied to depth sounder data before it can be used for charting. The third is a survey technique which should perform accurate hydrographic surveys at a significantly reduced cost and with significantly reduced manpower.

Hull, W.

The national tide and water level observation network: uses and applications. Symposium on Measurement, Mapping, and Management in the Coastal Zone, Virginia to Maine, New York, New York. May 1979, p. 205-216.

The National Ocean Survey (NOS), a component of the National Oceanic and Atmospheric Administration within the Department of Commerce, was established by Congress in 1807 to chart United States coastal waters and was the first technical agency of the Federal Government. In meeting its legislated responsibility of producing nautical charts, NOS has made tidal measurements since the early 1800's. Data from these observations are provided to all private, State, and Federal interests without interference in the responsibilities or prerogatives of any person, organization, or government unit. The demand for and application of these tidal data has grown, until today the data have uses ranging from nautical charting, engineering design, and basic research in marine boundary determinations. This paper describes the present tide and water level datum system of the United States, developments in automating tidal reducers, and engineering efforts to improve the tide and water level data acquisition systems.

Hull, W., Collins, J.

Technical assistance available from the National Ocean Survey. Proceedings of Symposium on Measurement, Mapping, and Management in the Coastal Zone, Virginia to Maine, New York, New York, May 1979, p. 14-19.

The National Ocean Survey's Photogrammetry (formerly Coastal Mapping) Division has established a mapping coordination group to cooperate with Federal, State, and local organizations in avoiding duplicative effort in surveying and mapping activities. This group will also provide technical assistance to agencies requesting help from NOS. This service is being offered to improve the quality and quantity of mapping products obtained by local organizations through a better understanding of requirements and available mapping capabilities.

Kalavaitis, A.

Dynamic test system for marine simulations. Seattle, Wash., 1979
Institute of Environmental Sciences Meeting, April-May 1979. (LISD)

Oceanic, estuarine, and limnologic circulation studies are conducted for many diverse purposes for which data of known quality are important: energy exploration and extraction, development and validation of models, climate research, and pollution and sediment transport to name but a few. Specifically, measurement of water flow is basic to the development of circulation models which are used to predict transport of energy related pollutants (oil spills, offshore drilling wastes, etc.). Most flow measurements are made with current meters, which are instruments that sense and record flow speed and direction as a function of time. The current meters' flow sensors are typically exposed to various time and length scales dynamics which may result in large measurement uncertainties, with errors higher than 100 percent not unusual. This paper describes a dynamic test system that can produce known, controlled dynamics for the performance evaluation of current meters and other marine devices such as wave height sensors. The apparatus, known as Vertical Planar Motion Mechanism (VPMM), generates three major modes of dynamics--vertical circular, vertical and horizontal--at length scales from .15 to 1.2 meters and time scales from 5 to 30 seconds. The VPMM mounts on a tow carriage which provides the steady velocity while the VPMM superimposes oscillatory motions on full size current meters. The VPMM is instrumented such that the instantaneous velocities of the test sensors and the corresponding outputs may be measured at a 20 Hz sampling rate; an on-board computer allows for near-real time data analysis. The development and acceptance testing of the VPMM using several types of current sensors is described. Examples are provided of sensor dynamic response and ocean wave height buoy calibrations.

Konop, D.

The Bay area survey expedition--recharting San Francisco Bay.
Sea Technology Magazine, March 1979.

San Francisco Bay and its navigable tributaries--San Pablo and Suisan Bays, and the Sacramento and San Joaquin Rivers--make up one of the Nation's busiest port regions. The key to safe navigation in this complex system of waterways, with its heavy commercial and recreational boating traffic and its bustling shore activity, is the suite of 16 nautical charts of the Bay Area produced by the National Ocean Survey (NOS), a component of the National Oceanic and Atmospheric Administration (NOAA).

Long, E., and Patchen, R.

Methods of automated tidal current chart predictions and automation of tidal current charts using computergraphics. NOAA/NOS Technical Report, Dec. 1979

The visual presentation of the tidal current regime, primarily used to insure safe navigation in United States coastal waterways, is a major product of the National Ocean Survey (NOS). For the publication of these tidal

current charts all previous techniques included the manual plotting of velocity vectors and station location charts. This procedure is time consuming, requiring hundreds of man hours for each set of charts. Since NOS is presently involved in numerous surveys of the coastal waters and estuaries of the United States, many tidal current charts for new regions and considerable updating present tidal current charts are anticipated. A new, less time consuming and cost beneficial method for the construction of tidal current charts has been developed. Utilizing computer graphic output on 310 mm microfilm, a computer program was written which allows ease of operation but complete user control (if required) for the construction of the final charts used for the publication. The 310 mm positive microfilm as the medium used by the printer for the final publication allows an easier and more efficient procedure for the final publication of the tidal current charts, and the microfilm is also an excellent medium for the archival of tidal current charts.

Lucas, J.

Refinement of Doppler positioning software: Ephemeris Interpolation.
2nd International Geodetic Symposium on Satellite Doppler Positioning.
January 1979.

When the program DOPPLER was first developed at DMATC, ephemeris interpolation was accomplished by fitting a Chebychev Polynomial to each of the three components of satellite position. Even though the ephemeris tables were computed at 1-minute intervals, for expediency the polynomials were fitted to a 2-minute ephemeris using only the positions and ignoring the velocities provided. This technique was more than adequate at a time when Doppler positioning was expected to produce accuracies on the order of 1 to 2 meters in each coordinate. In 1973, when the National Ocean Survey's National Geodetic Survey (NGS) began using program DOPPLER, it modified the ephemeris fitting routine to use a 1-minute time interval, but continued using the same basic procedure. However, as improvements in the program and observing procedure led Doppler positioning enthusiasts to consider sub-meter accuracies, it became apparent that errors in satellite position, introduced by the interpolation procedure, were no longer insignificant.

Malahoff, A., Embley, R. and Fornari, D. (Lamont-Doherty Geological Observatory of Columbia University)

Geological observations from ALVIN of the Continental margin from Baltimore Canyon to Norfolk Canyon. EOS, Vol. 60, No. 18, May 1, 1979.

In 1977 and 1978, eight ALVIN dives were made along the U.S. continental margin between Baltimore and Norfolk Canyons. Four of the dives were made in intercanion areas in depths ranging from 200 to 1800 meters, three were made within Norfolk Canyon and one was made in Washington Canyon. Of the intercanion dives, on only one, made across the shelf break beginning at 700 meters, were any rocks or outcrops observed, even though slopes as steep as 20-25° were traversed on several dives. These were erratics which have moved from the outer shelf into deep water. On one dive, south of Baltimore Canyon, a traverse was made of a well-defined slip plane of a

sediment slide. The scarp face did not show any evidence of instability. The dives in the upper regions of Norfolk and Washington Canyons traversed areas of massive outcrops of Lower Pliocene age which can be correlated with boreholes. Those in the Norfolk Canyon at Depths of 1500 and 2200 meters water depth traversed areas of thinly bedded deposits of Pleistocene age. These are either channel overbank deposits or are contourites which have been eroded by the channel. The overall impression from the dive observations was that the upper rise and slope in these regions both within canyons and in intercanyon areas, is a rather tranquil environment. In fact, bioerosion by crabs and other organisms, seem to be the dominant mechanisms in moving sediment and altering the underwater landscape at present.

Martin, D.

The National Ocean Survey marine boundary program. Presented to the Inter-divisional Committee on Marine Surveying and Mapping - ACSM. September 1979.

The National Ocean Survey began systematic tide observations in 1844 to provide vertical control for hydrographic surveys. Because of the need to continuously revise and update nautical charts, a permanent network of its stations was established. The network was expanded to keep pace with new areas being surveyed. This network of long-term tide stations is now called the National Tide Observation Network and consists of approximately 174 stations, 77 of which have collected over 19 years of continuous data. Several of these stations have over 100 years of continuous data. The significance of the 19 year period will be addressed later. It is this network of tide stations that provides the data base necessary for computing accurate tidal datums for the Marine Boundary Program.

McCaffrey, E.

A review of the Bathymetric Swath Survey System. Second United Nations Regional Cartographic Conference for The Americas, September 1979.

The appearance in recent years of large ships with drafts approaching 30 meters has a serious impact on U.S. charting requirements. Previously, detailed harbor approach surveys were accomplished sufficiently to define hazard within the 20 metre contour. The new, larger commercial ships now require surveys to assure that all hazards and obstructions within 30 meters of the surface are located in charted channels, harbor approaches, and ship fairways. A multi-beam bathymetric swath survey system (BS³) described here has the potential to meet these new survey needs. The BS³ employs a vertical fan-shaped array of 21 acoustic beams which forms a swath beneath the survey vessel with a width equal to 2.6 times the sounded depth. In addition to the usual vertical acoustic sounding, the oblique acoustic soundings are recorded and processed in real time to display contours of bottom features shallower than the vertical depth. A computer is part of the BS³, utilizing a real time operating system to merge soundings, navigation inputs, real time telemetered tides and ship motions to output corrected soundings graphically and to a magnetic data tape. System development began in July 1976 and was delivered in September 1977. Preliminary field tests on a Government launch

and recently concluded aboard the NOAA survey ship DAVIDSON are now being evaluated and the data analyzed. Indications are that the system will soon be certified and delivered to the NOAA survey fleet as an operational marine chart survey system.

Meissl, P.

A priori prediction of round off error accumulation during the direct solution of a super large geodetic normal equation system. NOAA Professional Paper NOS, NGS, May 1979.

The theory of roundoff errors for linear equations is adapted and applied to a special linear system of some 350,000 unknowns. The system represents the normal equations of the U.S. ground control network that is undergoing a new adjustment. The system is positive-definite and sparse. Cholesky's algorithm is used to reorder the equations by means of the Helmert-blocking technique. The block design is based on the idea of nested dissection. A linear stochastic roundoff error propagation model is used. Two families of computers are considered that come close to represent the two extremal cases of true chopping and true rounding. These families are represented by the CDC 6600 (with the rounding option set into effect), and the IBM 360. A thorough investigation of structural properties of the U.S. network that are relevant to roundoff error propagation is undertaken. Next to the large size of the network, weight singularities associated with observations of extremely high accuracy cause some concern. Bounds on bias and standard deviation of the individual components of the solution vector are derived. They indicate that the new adjustment is feasible on both types of machines.

Mero, T.

Laboratory and field experience with a Grundy Environmental Systems Model 9400 CTD system. Presented to the 5th STD/ocean systems conference, March 1979.

A Grundy Environmental Systems Model 9400 Conductivity/Temperature/Pressure (CTD) system was used by NOAA's National Ocean Survey as part of a comprehensive oceanographic survey conducted in the Gulf of Mexico. The system was calibrated by the Test and Evaluation Laboratory (T&EL) prior to its installation onboard the NOAA Ship FERREL. Following 8 months of survey operations, the 9400 system was returned to T&EL for recalibration. This paper describes the measurement capability of the 9400 CTD system based on the data from the initial calibration and the recalibration. Also presented are the Estimated Overall Uncertainty (EOU) and transfer functions for the three sensors in the system.

Meyer, E.

Environmental effects of sewage sludge at the Philadelphia dumping site. Stony Brook, N.Y., June 1979.

The Philadelphia sewage sludge disposal site is located about 70 km east of Ocean City, Maryland. Sludge has been dumped at the site since 1973, and the environmental effects of the practice have been under detailed observation since that time. The site was in pristine condition at the advent of sludge dumping. Since then clear trends of environmental modification and degradation have appeared in the areas contaminated by sludge. The changes seem limited to the ocean bottom environment, and include: increasing concentrations of metals and other toxic materials in organisms and sediments; changes in community structure; changes in abundances of different species; increased rates of mortality in shellfish; accumulation of sludge beds; appearances of sewage bacteria; and appearances of pathological conditions in resident crustaceans.

Milbert, D.

Optimal design and horizontal control networks. American Congress on Surveying and Mapping, Washington, D.C. March 1979.

A well-known result in theory of least squares adjustment is that the accuracy a network attains does not depend upon the actual values of the observations. Because of this, it is possible to develop a network design in the office. Any superior network design will meet desired accuracy requirements at a comparatively low cost. One technique of automatically designing and evaluating such networks relies upon the use of mathematical programming. When designing horizontal control networks, it is important to keep such designs free of the effects of a fixed point. This is implemented by use of the pseudoinverse and of rotationally invariant constraints. Results are displayed which illustrate the utility of optimal design technique.

Milbert, D.

Optimization of horizontal control networks by nonlinear programming. NOAA Technical Report - NOS/NGS, February 1979. PB80 117948.

For those with the responsibility to supply horizontal control, the design of geodetic networks to provide such control is an important problem. Developing a network design to meet particular accuracy standards can be done before any observations are made, because the accuracy a particular design attains does not depend upon values of the observations. All that is required is knowledge of the accuracy of the proposed observations. Traditionally, general guidelines developed over many years were the only criteria for network design. Deficiencies discovered after completion of the field work could only be remedied by expensive reobservation. The invention of the electronic digital computer provided the technical capability of detailed analysis of a design before field work commenced. Such detailed analysis ensures that a given network design will meet user requirements. Further, the computational resources provided by modern computers allow modeling of the economic implications of design. A more unified view of a geodetic network design is the result of these considerations.

Milbert, D.

Roundoff accumulation at weak horizontal positions. Bulletin Geodesique, December 1979.

This paper examines computer roundoff error accumulation in the least-squares adjustment of horizontal geodetic networks containing positions of very poor geometry. Roundoff error accumulates at the weak unknowns but does not disturb the solution of well determined positions. Numerical results are given.

Monica, S.

Continental slope sediment slump project for the Eastern seaboard. Ocean Engineering Technical Bulletin, September 1979.

NOAA's National Ocean Survey (NOS) began initial research into the origins of sediment instability along the United States Atlantic outer continental shelf and slope in 1977. Data obtained in this long-range study will be used to provide environmental information that will be useful for the evaluation of potential hazards and risks of installing and operating equipment on the outer shelf and slope.

Moore, T.

NOAA Fleet communication support. Radio Technical commission for marine services, San Francisco, Calif., April 1979.

This paper describes the NOAA Fleet and Communications used to support NOAA Marine Programs. Communications Management via Headquarters and operations support via Marine Centers and supporting coast radio stations is described. Information is provided on organization, radio frequency management, reports, operational procedures and ships of the NOAA Fleet. Requirements for safety of the NOAA Fleet with Equipment and Fleet Inspection are described as well as communication paths for normal and disaster communications. Office of Fleet Operations Instructions pertaining to Fleet Electronic Support of Inventory and maintenance are lighted. Emphasis is on providing an overview of what the NOAA Fleet is, what it does, and how communications are managed to provide effective Fleet Communications Support.

Moses, R.

National Ocean Survey Automated Information System. International Symposium on computer-assisted cartography ACSM/ASP Reston, VA, November 1979.

The National Ocean Survey Automated Information System (NOS/AIS) is a system developed by the Planning Research Corporation, Information Sciences Company, to provide on-line storage for the features of nautical charts published by the National Ocean Survey. The AIS provides cartographic personnel the capability of maintaining the nautical charts and supports the

production of new and up-dating of existing charts in an inter-active environment. The cartographer may specify placement and include or omit charting symbols on a trial basis, while editing and monitoring the results on a five-color display cathode ray tube (CRT). The cartographer also has the capability to enter line segments and change existing cartocodes. If the data is to be manipulated at a work station, it must first be present as a work file which exists on a disk pack attached as a peripheral to the work station computer system. The work file is created by a data retrieval request to the central site computer system. The NOS/AIS resides in a multi-processor system located in the NOS building complex in Rockville, Maryland. The system is designed to support up to ten work stations.

O'Connor, T., Park, K.

Consequences of industrial waste disposal at Deep Water Dumpsite 106. Mesa symposium of Ecological effects of environmental stress New York, N.Y., June 1979.

The consequences of dumping wastes at deep sea sites depend on diffusion of the material by barge-generated turbulence, subsequent oceanic mixing processes and the depth of the thermocline, chemical alterations of waste in the marine environment, and on biological responses to waste at the relevant concentrations and in the form determined by interaction with the ocean. In the absence of waste accumulation on the sea floor, any cumulative effect of periodic dumping depends on the relationship between dumping frequency and residence time of seawater at the site. Initial dilution factors of 10^4 are easily obtained but subsequent dilution via oceanic mixing can be very slow. This yields for 40km dumps of 4×10^6 l in the presence of a 15m thermocline depth, very narrow and slowing growing plumes. For example, if waste is uniformly distributed above the thermocline and uniformly distributed in width, the widths for dilution factors of 10^4 , 10^5 , and 10^6 are 50, 500, and 5,000m but this latter dilution, in the absence of a storm, may not be reached for several days after a dump. Chemical modifications include the formation of precipitates, adsorption of waste constituents onto precipitates, and degradation or volatilization of organic compounds. Biological studies show oceanic phytoplankton to be more sensitive to waste than coastal or estuarine organisms and zooplankton can suffer sublethal effects such as decreased feeding rates. It is hypothesized that due to existing dumping there may be changes in species composition of phytoplankton communities.

Park, K.

Ocean dumping research and monitoring at Puerto Rico dumpsite. Environmental Protection Agency regional meeting, Ocean City, Md., November 1979.

The Puerto Rico dumpsite located 74 km north of Arecibo, Puerto Rico, is approximately 500km² area (19°10' to 19°20'N and 66°35' to 66°50'W) overlying 6000 to 8000 m of seawater (figure 1). Since 1972, under EPA permit it has been receiving industrial waste, about 85 percent of which is derived from seven pharmaceutical plants with the remainder being an alkaline solution

of hydrogen sulfide from a hydrocarbon refining company. The sulfide disposal occurs separately while the pharmaceutical wastes (except one) are mixed prior to loading onto the dumping barge. These wastes, trucked from the various plants, accumulate in a holding tank until on two or three consecutive days, they are dumped in 2.5 million liter lots over a distance of about 35 km. Tables 1 and 2 are lists of the waste contributing plants and annual total dumped volumes, respectively. Since 1978, the NOAA Ocean Dumping and Monitoring Division has been conducting a program to define the environmental consequence of pharmaceutical waste dumping at the Puerto Rico site. This discussion concerns results to date and a description of ongoing work. It is presented in sections dealing with waste characteristics, dispersion, advection, and biological effects.

Park, K.

Ocean dumping research: historical and international development. NOS Ocean dumping symposium book volume, July 1979.

Plans for systematic and comprehensive ocean dumping effect research and monitoring were prepared in 1970, followed by their execution in recent years. Thirty-nine nations have joined the international convention on the "Prevention of Marine Pollution by Dumping of Wastes and Other Matter" that became effective on August 30, 1975. At present, internationally prohibited substances from being ocean dumped include organohalogen, mercury, cadmium and their compounds, persistent plastics, high-level radioactive wastes, and biological and chemical warfare agents.

Patchen, R., Cheng, R. (USGS)

Current survey of San Francisco Bay by NOS and USGS. American Geophysical Union San Francisco, Calif., December 1979.

The San Francisco Bay estuarine system consists of navigable South Bay, Central Bay, San Pablo Bay, Suisun Bay, and other tributaries. It is one of the nation's busiest waterways and most complex aquatic ecosystems. Both the Nation Ocean Survey (NOS) and the U.S. Geological Survey (USGS) have conducted current surveys in the Bay system in the past, and presently a joint comprehensive program is being carried out to measure the important oceanographic parameters in San Francisco Bay including extensive and systematic observations of (1) circulation patterns, (2) water level fluctuations, (3) meteorological parameters, and (4) density regimes. The research, encompassing all these problem areas, is being done in three phases. The first phase of the program took place between 5 February and 7 May, 1979; it was primarily conducted by the NOS with support by the USGS. The second phase, a combined effort of NOS and USGS, began in mid-September 1979 and will continue through mid-December 1979. Between mid-December 1979 and February 1980, the USGS will maintain several important reference stations when the NOS team will be resupplied in Seattle, Washington. The final phase of the measurements will be conducted between February 1980 and September 1980 by using combined NOS/USGS data collection capabilities. This program will provide an extensive data

bases on water circulation in the San Francisco Bay estuary which will allow for years of intensive interdisciplinary investigations. The data collected will be immediately used for: (1) comparison of NOS and USGS current-measuring system; (2) updating of the Tidal Current Tables and Charts for San Francisco Bay by NOS; and (3) implementation in the modeling efforts of the Bay system by USGS.

Perry, L. H.

The controller and operating system of NOSAP and its potential for on-line aero-triangulation. National research council, Ottawa, Canada, May-June 1979.

The controller and operating system of NOSAP (the National Ocean Survey Analytical Plotter) together create a sophisticated and powerful data processing system that offers considerable potential for on-line aero-triangulation, as well as for many other photogrammetric applications. The mainframe controller is a PDP 11/45 with several features that permit optimizing the speed of various photogrammetric tasks, the most critical of which is the real-time software to drive the viewer and plotting table. Some of these features include a floating point processor, Unibus architecture, 128K 16-bit word memory, fast bus and MOS memory, programmable clock, and hardware interrupts. The RSX-11M operating system is used to take advantage of some of its nice features, the primary feature being its multitasking ability. Additional features make it possible for the user to tailor the RSX-11M system to the hardware and software needs of the system. The combination of the PDP 11/45 controller and RSX-11M operating system permits the use of real-time software, multitasking, file control, and data management that are required in sophisticated on-line aero-triangulation.

Perry, L. H.

Field preparation of high precision analytical photogrammetry. Washington, D. C., ASP/ACSM convention, March 1979.

In October 1975 the National Ocean Survey performed an extensive prototype project for geodetic densification using high precision analytical photogrammetry. This project was named UNPHOG and included some deviations from conventional analytical photogrammetry in an effort to maximize the accuracy in the system. This effort included increased geometric strength by altering photographic flight plan, application of reseau to control systematic errors mainly from film deformation, and control measured images by targeting pass points. The results of this project showed that geodetic positions are feasible from photogrammetry. Since the success of UNPHOG, a similar project has been undertaken on the operational level in Ada County, Idaho. The field work for the Ada County project was completed October 1978. This paper discusses the field effort for geodetic densification through analytical photogrammetry and includes the target configuration, the logistics, and the cost in field preparation involving more than 300 targets.

Petty, J.

Determination of Astronomic position for California - Nevada boundary monuments near Lake Tahoe. NOAA Technical Memorandum, October 1979. PB301264.

At the request of the California State Lands Commission, NOAA/National Ocean Survey's National Geodetic Survey conducted astronomic observations at three California-Nevada boundary monuments near Lake Tahoe to verify the reported position of the 120th meridian, as set forth in U.S. Coast and Geodetic Survey Report for 1900, Appendix no. 3. Results and documentation are provided.

Phillips, J.

Cooperative efforts in geodetic and cartographic technology. Technology exchange week, Panama City, Panama, May 1979.

Preparing for the future accents the importance and need for geodetic and cartographic products. The disciplines of mapping, charting, and geodesy have known for many decades what these needs are and what should be done to accomplish them. Now these needs are being recognized and appreciated by the users we have been trying to educate. I am referring to the planner, the environmentalist, the attorney, the social welfare advocate--not only the scientist and engineer. Nevertheless, the organizers of this conference have confidence that we will move forward and overcome these difficulties. A week devoted to a technology exchange is an admirable undertaking. The National Oceanic and Atmospheric Administration/National Ocean Survey/National Geodetic Survey (NGS) will benefit from these discussions. I trust that our activities are of interest.

Poetzschke, H.

Motorized leveling. The International Conference on the Redefinition of North American Vertical Networks, Panama City, Panama, January 1979, and the ASP/ACSM Convention, Washington, D. C., March 1979.

Since the early 1950's various forms of motorized leveling modes have been attempted to speed up leveling operations. Faster progress in leveling is a desirable goal since observations have to be taken in the most critical part of the atmosphere near the surface of the ground. A short review of the existing systems of motorized leveling is given and the operational system of the National Geodetic Survey described. Finally, results are given which have been achieved with the NGS system.

Ribe, R.

Waves sensors study. NOS Technical Report, May 1979.

An extensive literature survey and study were combined with experiences by personnel of the Test and Evaluation Laboratory, National Ocean Survey, to determine the present status of ocean wave sensors and to catalogue the available literature in a logical pattern. Most of the wave sensors which have been reported are described. Radar-based sensors, an extensive and complex area of measurement, have been omitted. Theoretical and observational studies of radar wave measurements are being made by NOAA's Wave Propagation Laboratory at Boulder, Colorado. Much of this report is based on study of extensive and scattered reports of the many approaches to ocean wave measurement. In nearly all instances the approach used in this report was to summarize use, experiences, and characteristics of each specific type of sensor and to relate this information to reports documenting analysis or experience.

Robertson, D.

Polar Motion and UT1; comparison of VLBI, lunar laser, satellite Doppler and conventional astronomical determinations. MIT and Northeast Radio Corporation meeting on Radio Interferometry, Westford, Mass., June 1979.

Very-long-baseline interferometry (VLBI) observations made with a 3900-km baseline interferometer (Haystack Observatory in Massachusetts to Owens Valley Observatory in California), have been used to estimate the variations in the X-component of the Earth's pole and in UT1. The determinations of pole position and UT1 are compared with the corresponding determinations from Lunar laser, satellite laser, satellite Doppler, and optical observations.

Robertson, D.

Submilliarcsecond astrometry via VLBI: I. Relative position of the radio sources 3C 345 and NRAO 512. The Astronomical Journal, May 1979.

The relative position and proper motion of the radio sources 3C 345 and NRAO 512 were estimated from four sets of very-long-baseline interferometric observations, spaced between October 1971 and 1974. Use of phase-connection techniques yielded the result

$$\alpha(3C345 - NRAO 512) = 2^m 29^s.43668 \pm 0^s.000 03$$

$$\delta(3C345 - NRAO 512) = 1' 40''.726 3 \pm 0''.000 3$$

for the separation in 1950.0 coordinates of the centers of brightness of the compact components of the two sources and an upper bound of 0''.0005 on their relative proper motion (70% estimated confidence limits).

Robertson, S.

Synchronization of clocks by Very-Long-Baseline Interferometry. IEEE Transactions on Instrumentation and Measurement, February 1979.

Two hydrogen-maser clocks, one at the Haystack Observatory in Massachusetts and one at the National Radio Astronomy Observatory in West Virginia, were synchronized by means of very-long-baseline interferometry (VLBI) observations of several extragalactic radio sources on March 28, and again on September 23, 1977. Observations were made sequentially in eight 360-kHz bands distributed between about 8.4 and 8.5 GHz with spacings designed to enable the group-delay difference between the signals received at the two observatories from a given source to be estimated unambiguously, within an uncertainty of less than 1 ns set by receiver noise. The epoch and the rate differences between the observatories' clocks for each experiment were estimated by analysis of observations that spanned several hours. The application of corrections for the contributions to the delays of the antennas, feeds, receiver systems, and recorders, yielded absolute determinations of the clock epoch differences. During each experiment, portable cesium clocks were flown from the U.S. Naval Observatory in Washington, D. C., to the observatories and back. The traveling-clock data, analyzed in each case after the VLBI synchronization had been completed, confirmed the VLBI results to within 18 and 14 ns for the first and second experiments, respectively.

Scherer, W.

An intercomparison of an acoustic remote current sensor and Aanderaa current-meters in an estuary. Acoustical Society of America Meeting, Salt Lake City, Utah, January 1979.

An intercomparison experiment of a single-axis bi-static acoustic remote current sensor and Aanderaa current meters was conducted during the fall of 1978 in the Patuxent River near Solomons Island, Md. The acoustic sensors were located on a platform at a mean water depth of 15/m and the acoustic axis pointed essentially downstream. The transmit frequency was set at 270 kHz, and the received signal was cabled to shore and heterodyned to 5 kHz. Up to 128 tone bursts of 10 m/sec duration were transmitted at 1 sec repetition time every 15 minutes. The back scattered volume reverberation data were analog recorded, subsequently digitized, and spectrally analyzed. The spectral estimates of the Doppler shift are derived for a number of range intervals and are compared with Aanderaa current speeds projected along the acoustic axis of the remote sensor. The comparison of the time series (15 minute intervals) extends over a number of tidal cycles.

Schwarz, C.

The new adjustment of the North American Horizontal Datum: Deflections of the Vertical (Article #15). Bulletin of the American Congress on Surveying and Mapping, May 1979.

Most existing horizontal geodetic datums, including NAD 1927, have been computed by the development method. This means that differences between the geoid and ellipsoid are completely neglected. In effect, the geoid and ellipsoid are taken to be synonymous. Measured distances reduced to sea level (i.e., to the geoid) are assumed to lie on the ellipsoid. Theodolites leveled in the real gravity field of the Earth (i.e., oriented along the astronomic normal or plumb line) are assumed to be oriented along the ellipsoidal normal. The development method, by ignoring the differences between geoid and ellipsoid, leads to errors in adjusted coordinates. These errors are reflected as distortions which tend to persist over areas of several hundred kilometers. Minimizing these distortions associated with the development method has historically been the reason geodesists have attempted to determine an ellipsoid which best fits the geoid. If the chosen ellipsoid fits well to the geoid in the area of consideration, then the distortions will be small. The alternative to the development method is the projection method. Both the geoid height and the deflection of the vertical must be known at every occupied control point, and directions and distances are properly reduced to the ellipsoid. A well fitting ellipsoid is no longer necessary, since the proper reductions are no longer neglected.

Segar, D. and Cantillo, A.

Metal species identification in the environment. ACS Environmental Health Chemistry Symposium, October 1979.

Since at least the Industrial Revolution, it has been known that many substances released by man into the environment can be hazardous to human health. Among the earliest such substances to be identified as health hazards were various toxic metals and inorganic nonmetals. The impact of synthetic organic compounds is, by contrast, a relatively recent development. The scientific community and the public at large generally perceive that there is a more complete understanding of the effects of contaminant metals on human health than there is of the effects of synthetic organic compounds. In consequence, there is also a widely held belief that the environmental concentrations and release rates that are considered safe, and which form part of many environmental control regulations, are more firmly based on a good understanding of just what the safe levels of metals in the environment are. Furthermore, it is believed that the heavy metal regulatory limits are more effective in ensuring human and ecological safety than are the corresponding regulatory limits for synthetic organic compounds. These general attitudes to the trace metal environmental hazard are at least partially founded. There is, for example, better information concerning the environmental discharge concentrations of trace elements than there is for many organic compounds because the analytical techniques for metals have historically been better developed and less expensive. Our understanding of the role and pathways of trace metals within the atmosphere, biosphere,

hydrosphere, and geosphere is much broader because it has been possible to study them for a period of decades compared to the few years that we have been able to study synthetic organics.

Slama, C.

Test results of high precision analytical photogrammetric system. 9th United Nations regional cartographic conference for Asia and the Pacific. Wellington, New Zealand, October 1979.

Spurred by advances in computer technology and measuring techniques, the NOAA's National Ocean Survey (NOS) began an investigation in 1975 of high precision analytical triangulation for possible applications to the densification of geodetic ground control. The system investigated employed a special camera lens cone with an incorporated projected reseau. All ground points are targeted before photography, the mensuration is partially automated, and optimum geometry of the photogrammetric solution is obtained by special flight-line configurations. The systematic errors normally encountered in photogrammetry are minimized by image optimization, calibration of the camera's lens inner geometry using stellar methods, thorough calibration of the camera reseau, multiple pointing during mensuration, complete calibration of the mensuration device, and rigorous treatment of the observations in the adjustment computation. Test data flown over the Casa Grande target range provided eight different photo coverage configurations to study the relationship between geometry and final accuracy. Final adjusted data for the optimum case show an RMS difference between geodesy and photogrammetry of .046 meters for 225 points. This represents a ratio of photo scale to error (in meters) of 516,158 or a five times improvement over that reported by NOS in previous experiments.

Smith, R.

Restore the beaches in Glen Cove, New York. American Shore and Beach Preservation Association Magazine, November 1979.

While more than 70 percent of the beaches on the north shore of Long Island are privately owned and maintained, Federal, state, and local governments have paid increasing attention to the planning and management of these privately owned beaches in recent years because of the problem of beach erosion. Scientists and engineers are studying beach behavior patterns both in model simulations and in the environment to better understand the "Forces of Nature" at work. Although the general configuration of the north shore of Long Island has not changed over the past 150 years, the beaches certainly have. Glen Cove, a community established in 1668, is located about 25 miles by water northwest of New York City along the north shore of Long Island. The general characteristics of the forces at work along the Sound with special attention to the history of Glen Cove's beaches since 1837, including the major natural processes and man-made changes that have occurred over the years along the shoreline.

Snay, R.

Geodetically derived strain at Shelter Cove, California. Bulletin of the Seismological Society of America, December 1979.

During 1976, as part of a program to monitor crustal motion, the National Geodetic Survey, NOS observed a small geodetic network in the Shelter Cove area of northern California. The network straddles part of the fault that ruptured during the 1906 San Francisco earthquake. Analysis of the new survey data, combined with those of a larger 1930 network, yields an estimate of $N. 13^{\circ}2' W. \pm 4^{\circ}5'$ for the direction of maximum right-lateral shear strain through the area. The mean shear strain rate in this direction is $1.01 \pm 0.18 (10^{-6})$ radians/year for the 1930-76 time interval.

Spencer, J.

Geodetic information and its availability. Presented to the Louisiana Land Surveyors Association, Alexandria, Va., November 1979.

The National Geodetic Information Center (NGIC) was established in 1972 as a division within the National Geodetic Survey (NGS) of the National Ocean Survey (NOS), National Oceanic and Atmospheric Administration (NOAA), U.S. Dept. of Commerce. Its mission is to collect, maintain, publish and distribute geodetic and cartographic information pertaining to the National Geodetic Networks. Prior to 1972, this task was performed by the Data Preparation Branch within the Geodesy Division of the U.S. Coast and Geodetic Survey (the Coast and Geodetic Survey was reorganized in 1970 and renamed the National Ocean Survey). However, the massive quantity of data involved the need to convert and publish all data in standard formats, the requirement to digitize (place in machine-readable form) this information, and the need to provide services for obtaining these data more efficiently necessitated the present organizational structure.

Spencer, J.

Publication and distribution of adjustment results. Bulletin of the American Congress on Surveying and Mapping, June 1979.

Successful completion of the future North American Datum 1983 will depend on three interrelated tasks; data gathering, data processing, and data distribution. Previous articles in this series have dealt with data gathering and processing activities. This article addresses the publication and distribution of the NAD83 results.

Spencer, J. and Wallace, W.

Uses of geodetic control networks. Presented to the ASP-ACSM Convention, Sioux Falls, South Dakota, June 1979.

The first network surveys, which began in 1816, were used to control nautical charts. Subsequent surveys extended across the continent to provide control for Federal mapping programs, boundary demarcation, nautical and aeronautical charts, and programs paralleling the growth and development of the United States. Most of the requirements were for traditional uses such as mapping, charting, and large scale engineering efforts including railroad and highway construction, dams, irrigation, and inland waterway improvements. Today's requirements have dramatically expanded the uses and need for geodetic control. Environmentalists, lawyers, economists, legislators, social scientists, and policy analysts all require information for which the national networks are the base. Along with the traditional uses of geodetic control, today's requirements include information for energy development and natural resource inventories, environmental planning and impact studies, defense and communications systems, flood plain designation and flood insurance investigation, satellite data collection, crustal motion studies and earthquake hazards reduction programs, boundary disputes, coastal zone management, and maps for tax assessment and land-use planning.

Stanley, W.

Map acquisition and automation of information services. Presented to the International Association of Marine Science Libraries and Information Centers, Charleston, South Carolina, November 1979.

The Physical Science Service Branch collects information for the compilation of maps and charts, and for the historical preservation of cartographic information. An automated system is now in the offing to create a new data base index system to reduce the physical handling, maintenance, and files created by the cartographic source material of the Branch. The system will be modeled after the U.S. Geological Survey's National Cartographic Information Center (NCIC). Within the NCIC and Automated Map and Chart Information System (MCIS) has been developed, whose system procedures are compatible with the needs of the Physical Science Services Branch and the needs of the compilation areas within the National Ocean Survey. The Requirement Study presently underway should indicate the types of hardware and software packages needed to achieve a system of source material, indexing, and distribution in keeping with the charting mission and user demands of the National Ocean Survey.

Stanley, W.

Surveying and cartographic accomplishments of George Vancouver to Pacific America. Proceedings of the 8th International Conference on the History of Cartography, Berlin, West Germany, September 1979.

George Vancouver was truly among the great explorers of the 18th century. His life was brief but in the short span of two-score years

(1757-1798) was crowded one of the most remarkable careers in the history of discovery. He lived during a sublime period in British history. At the time of his birth exploration of the new world was well underway and other conflicts such as the Seven Years War had already begun. Vancouver was born on June 22, 1757, at King's Lynn, Norfolk, at that time a seaport north of London. He was the sixth child and third son of Bridget and John J. Vancouver. His father held a prominent position with the government as customs collector of the port. During this period the seaport of King's Lynn was a major depot of the Empire. Vancouver's father had considerable influence in marine matters that no doubt had its effect on his son's interest to follow a career at sea. By the time he was fifteen his adventurous spirit was evident and in keeping with the sons of influential nobility he joined Capt. Cook's ship the RESOLUTION to begin his distinguished career at sea. Vancouver was fortunate for the personnel aboard Cook's ship were of an unusually high caliber. An example were the many valuable experiences he had with William Wales, an astronomer with the expedition and one of the leading authorities in his field. Wales was instrumental in developing the astronomical formula of finding longitude at sea. Vancouver was later to name a headline Point Wales along the southern coast of Alaska in honor of his teacher. As the Roberts expedition took shape, the Ship DISCOVERY became the main center of concern. The DISCOVERY had been purchased by the Admiralty late in 1789 and was commissioned as a Sloop of War on January 1, 1790. The vessel was then moved to a dockyard located on the Thames between London and Greenwich and rigged for surveying work. At 340 tons and 101 crew members, she was well equipped to handle a long voyage at sea. In April, 1790, just before the ship was ready to sail, news was received of the seizure by the Spaniards of the English factories at Nootka Sound as well as an English ship commanded by Captain John Meares. As a result of this information, the DISCOVERY was immediately armed for any contingency and the Roberts expedition was cancelled. Formidable action by the British induced Spain to yield and offer restitution. Settlement by Spain came from the Nootka Sound Convention held in Madrid, November 1790. This incident caused the British government to review the national importance to Great Britain of the northwest where extensive fisheries and the fur trade with adjacent regions had already become important to England.

Stem, J.

Readjustment of triangulation and the impact on land data systems. Presented to the 18th Annual Surveying and Photogrammetric Conference, Fresno, Calif., January 1979.

Several topics will be reviewed dealing with the readjustment of the North American Datum (progress, methodology, and anticipated results). The international concept of a land data system will be discussed and the presentation will be concluded with the impact of the readjustment on the land data system.

Summerhayes, C. P., Bornhold, B. D. and Embley, R. W., 1979

Surficial slides and slumps on the Continental slope and rise of Southwest Africa: a reconnaissance study. *Marine Geology*, 31: 265-277, 1979.

Off South West Africa, a large slide and a large slump have displaced about 250 km of surficial sediment from the lower continental slope onto the upper continental rise. The slide and slump scars together cover an area of 600 km²; they affect only the upper few tens of meters of the sediment column. A debris flow extends about 250km downslope from the slide scar, and deformed sediments extend a similar distance downslope from the slump scar. Apparently the slide and the slump were triggered during the late Pleistocene; neither of them gave rise to turbidity currents. Slides and slumps like these appear to be common on both active and passive continental margins. Their presence in these environment merits careful study in view of deep water exploration and production drilling for oil and gas.

Vincenty, T.

Adjustment computations in height-controlled space. *Survey Review*, June 1979.

The height-controlled three-dimensional system for adjustment of geodetic networks, proposed in [2] and modified in [1], offers considerable advantages over conventional adjustment methods. This system uses observations without corrections to reduce them to a computational surface. Distances are straight lines in space, azimuths are astronomic, and angles are as measured in the plane perpendicular to the direction of gravity. The adjustment is performed by the method of variation of parameters, with astronomic latitudes ϕ , astronomic longitudes λ , and geodetic heights H held fixed as previously established. The coordinate unknowns, i.e., the changes in the assumed positions of the points, can be expressed in Cartesian equatorial coordinates (X, Y, Z) , or in geographic coordinates (B = latitude, L = longitude), or as shifts dx and dy (north and east) in the astronomic horizon plane. For the present purpose the last mentioned coordinate system will be used.

Vincenty, T.

Determination of North American Datum 1983 coordinates of map corners. NOAA Technical Memorandum, NOS NGS, March 1979. PB297245.

This publication contains predictions of changes of coordinates of points from the North American Datum 1927 to the North American Datum 1983 on the basis of the latest data.

Vincenty, T.

Height-controlled three-dimensional system for adjustment of networks.
Bulletin Geodesique, May 1979.

The principles of three-dimensional geodesy are used in adjustment of horizontal networks with heights and astronomic coordinates held fixed. Three coordinate systems are used for coordinate unknowns, the choice of which depends on preference. Differences in spatial coordinates are included as observations. The proposed method is decidedly simpler and faster than any conventional method.

Vincenty, T.

HOACOS: A program for adjusting horizontal networks in three dimensions.
NOAA Technical Memorandum, NOS NGS September, 1979. PB301351.

Horizontal networks are adjusted in the simplest way by using the mathematical model of the height-controlled spatial system. A computer program based on this method is described.

Vincenty, T. and Bowring, B. (United Kingdom).

Use of auxiliary ellipsoids in height-controlled spatial adjustments
NOAA Technical Memorandum, NOS NGS, August 1979. PB80 155104.

In an adjustment of a geodetic network in the height-controlled three dimensional system it is convenient to use auxiliary ellipsoids. These surfaces are used for preserving correct heights of points and for simplifying the transformation of adjusted Cartesian coordinates to the geographic system.

Ward, G.

Evaluation of calcium sensors in fresh and salt water. NOAA/EPA Interagency Program Report, February 1979.

The Orion Calcium Ion Electrode #93-20 was evaluated for suitability as a calcium ion sensor for either monitoring or in situ marine applications. The electrode was tested with three separate sensor modules for the following parameters: accuracy, precision, temperature dependence, short and long-term stability, durability, sensitivity to fluctuations in light intensity and flow conditions, response time as a function of temperature and concentration, and variability between modules. The three sensors of the "liquid ion-exchange" type were evaluated at 10°C and 25°C in freshwater, synthetic seawater (35-, 20-, and 5-ppt salinity) and natural waters (IAPSO standard seawater, Atlantic Ocean water, and Chesapeake Bay water). A description of the sensor, theory of operation, and a summary of the test results are included. The electrode response for two of the modules was a linear function of the logarithm of calcium concentration. All three modules failed prematurely (i.e., before the 6-month guaranteed period). While the accuracy

in high salinity samples (35 and 20 ppt) was poor, the concentration measurement was better than 7% in 5-ppt salinity seawater and indicates a susceptibility of the sensor to the "salt-extraction effect" which results in electrode drift and abnormal inaccuracy in salt solutions. The long response times (i.e., average of 33 minutes in freshwater) and sensitivity to flow conditions make the practical application of this calcium sensor to in situ measurements a somewhat dubious proposition.

Ward, G.

Evaluation of ion-selective electrodes for seawater measurements. Presented to the symposium of the Electrochemical Society, October 1979.

Ion-selective electrodes have recently received considerable attention as simple, inexpensive analytical tools. Due to their compactness, durability and specificity, these sensors have been proposed as direct in situ sensors as part of water quality measurement system. Marine chemistry research, effluent and pollution monitoring, baseline surveys and water mass mixing studies. To determine the suitability of these sensors for measurements directly in the oceanic or estuarine environments, tests were performed on 16 commercially available ion selective electrodes produced on 7 different manufacturers for the following chemical parameters: calcium, sodium, potassium, magnesium, chloride, and fluoride. Since several different types of electrodes were available, at least one sensor with each type of membrane was tested (i.e. glass-bulb, liquid ion-exchange, and solid-state electrodes). Each electrode was evaluated for accuracy; precision; response times as a function of concentration and temperature; sensitivity to variations in ambient light intensity, flow around the sensor, and physical motion; response linearity; long-and short-term stability or drift; effects of salinity and temperature on the calibration curves; and the variations between manufacturers. The tests were performed in pure water, synthetic seawater at 35-, 20-, and 5-ppt salinity, IAPSO Standard Seawater (35-, 20-, and 5-ppt salinity), Atlantic Ocean water, and Chesapeake Bay water (5-ppt salinity).

Ward, G.

Evaluation of the orion divalent specific ion electrode. NOAA/EPA Interagency Program Report, March 1979.

The Orion Divalent Cation Specific Ion Electrode #93-32 was evaluated for suitability in monitoring, or in situ, marine applications as a magnesium ion sensor. The electrode was tested with three separated modules for the following parameters; accuracy, precision, temperature dependence, short- and long-term stability, durability, sensitivity to variations in light intensity and flow conditions, response time as a function of temperature and concentration, and variability between modules. The "liquid ion-exchange" sensor was evaluated at 10°C and 25°C in freshwater, synthetic seawater (35-, 20- and 5-ppt salinity), and natural waters (IAPSO Standard Seawater, Atlantic Ocean water and Chesapeake Bay water). A description of the sensor, theory of operation, and a summary of the tests and results are included. Although two of the modules supplied with the electrode failed

prematurely, the third replacement module performed well in all media with an accuracy of 5% in magnesium concentration when properly calibrated on a daily basis. The response times were generally longer than expected, ranging on the average from 3 minutes in seawater to 26 minutes in untreated freshwater. The electrode was relatively insensitive (± 0.2 mV) to external wire motion, flow conditions, or variations in light intensity.

Ward, G.

Test and evaluation of potassium sensors in fresh and salt water. NOAA/EPA Interagency Program Report, February 1979.

Three different types of Potassium ion-selective electrodes, manufactured by three different companies, were evaluated for suitability for application in monitoring or in situ chemical analysis systems. Each sensor was tested for the following parameters: accuracy, precision, temperature dependence, short- and long-term stability, durability, sensitivity to variations in light intensity and flow conditions, response time as a function of temperature and potassium concentration, and variations between different manufacturers. The three sensors (glass-membrane single electrode, glass-membrane combination electrode, and liquid ion-exchange electrode) were evaluated at 10°C and 25°C in fresh-water, synthetic seawater (35-, 20-, and 5-ppt salinity), Atlantic Ocean water (35- and 20-ppt salinity), and Chesapeake Bay water (5-ppt salinity). A description of the devices, the theory of their operation, and a summary of the tests and results are included. Although all three electrodes performed well in freshwater, the results with the liquid ion-exchange electrode were significantly better in seawater than those with the two glass-membrane electrodes. An accuracy of 5% in concentration could be achieved with some of the sensors when properly and frequently calibrated. The response times (95%) were unexpectedly long for all the sensors and were generally greater than 10 minutes. While none of the electrodes were affected by changes in light intensity, the two glass-membrane sensors were sensitive to external motion and flow variations.

Welch, J.

Circulation and hydrodynamics of the lower Cape Fear River, North Carolina. NOAA Technical Report, February 1979.

The results from the harmonic analysis of the data from tide and current stations in the lower Cape Fear River are presented in the form of tables, cotidal and corange charts, and charts illustrating the relationships among various harmonic constituents. Salinity and temperature data are presented in the form of contours of longitudinal transects, and time series stations covering full tidal-cycles. Instrumentation, data products, and the various methods-analysis are described. The implications from the results of the various methods of analysis relative to the circulation and hydrodynamics of the lower Cape Fear River are discussed.

Wessells, C.

Gravity observations in support of the National Geodetic Vertical Datum. Presented to the International Conference on the Redefinition of the North American Vertical Control Network, Panama City, Panama, January 1979.

A need for an effective vertical reference datum by surveyors, mappers, engineers, and scientists propelled the National Geodetic Survey (NGS), to initiate a new general adjustment of the entire Vertical Control Network of North America. This enormous task involves releveling approximately 100,000 kms of the 120,000-km Basic Net A. Since measured gravity is important in calculation errors in geopotential height differences, observations will be made in conjunction with this releveling over the entire 120,000 kilometers. This paper describes the methods and procedures that NGS's Gravity, Astronomy and Satellite Branch will employ for its gravity operations.

Whalen, C.

The National Geodetic Vertical Datum readjustment program. Presented to the International Conference on the Redefinition of the North American Vertical Control Network, Panama City, Panama, January 1979.

NOAA/National Ocean Survey (NOS) is undertaking a National Geodetic Vertical Datum (NGVD) readjustment program. The NGVD program will be accomplished in the years 1978-1985, at an estimated direct cost of \$26 million and require 928 staff years. The framework for the readjustment will be Basic Net A which consists of 120,000 km of first-order level lines. Surveys are being conducted to relevel and replace destroyed marks on 100,000 km of level lines of Basic Net A, using first-order procedures. An additional 20,000 km of first-order leveling, observed since 1963, will be considered for inclusion in Basic Net A. Any portion of this recent leveling that does not form satisfactory loop closures with the new work will be relevelled. Data for 728,000 km of previous leveling observations and descriptions will be obtained from the archives, automated and loaded into the NGS data base. Geographic positions will be determined from maps for all bench marks loaded in the data base. A study will be made to determine how to define the datum for the new adjustment. The entire National network of first- and second-order leveling will be readjusted to produce a homogeneous set of new heights on a common datum. The readjustment will be accomplished in geopotential units using gravity values observed on bench marks or interpolated from data base files. After adjustment, the geopotential heights will be changed to a height system, as yet unspecified, for publication distribution.

Whalen, C.

Report on the U.S. National vertical control network. Presented to the International Conference on the Redefinition of the North American Vertical Control Network, Panama City; Panama, January 1979.

The U.S. National geodetic vertical control network consists of 700,000 Kilometers of first- and second-order leveling. Approximately 200,000 km of the network have been releveled. The National tide observation network consists of 168 long-term primary and secondary tide stations. Many published elevations for bench marks of the National network are no longer valid because crustal movements have occurred since the surveys were made. Gravity coverage over much of the country is adequate for computing heights based on observed or interpolated gravity values instead of normal gravity values. In the 1900-1962 time period, the U.S. Coast & Geodetic Survey (USC&GS) manufactured and used the Fisher level and 1-cm checkerboard invar band rods. The Jenoptik NI 002 reversible compensator level, designed for motorized leveling, and the Kern 0.5 cm double-scaled invar band rods are now standard instruments for the National Oceanic and Atmospheric Administration's (NOAA), National Ocean Survey (NOS) and National Geodetic Survey (NGS) leveling surveys. Since 1976, NGS leveling teams have recorded observations on programmable calculators. The calculators apply acceptance checks and write acceptable data on tape cassettes for transfer via terminal to the central computer in Rockville, Maryland. The terminal is also used to operate programs on the central computer for editing descriptions and observations, and for preparing field abstracts. The descriptions and observations are converted to standard NGS data base formats by the central computer.